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AUTHOR'S EDITION.

DEPARTMENT OF THE INTERIOR.
UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY.
F. V. HAYDEN, U. S. Geologist-in-Charge.

REPORT

ON THE

GEOGRAPHICAL FIELD WORK

IN THE

YELLOWSTONE NATIONAL PARK.

BY

HENRY GANNETT.

EXTRACTED FROM THE TWELFTH ANNUAL REPORT OF THE SURVEY FOR THE YEAR 1878.

WASHINGTON, June 13, 1883.

SECTION III.

TOPOGRAPHY.

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VALLEY OF THE YELLOW STONE RIVER.

LOOKING SOUTH FROM THE FIRST CANON.

GEOGRAPHICAL FIELDWORK OF THE YELLOWSTONE PARK DIVISION.

By Henry Gannett, E. M.

LETTER OF TRANSMITTAL.

WASHINGTON, D. C., *September* 26, 1881.

SIR: I have the honor to transmit herewith my report on the field-work of the Yellowstone Park Division, United States Geological Survey of the Territories, during the season of 1878.

Very respectfully yours,

HENRY GANNETT.

Dr. F. V. HAYDEN.

ITINERARY.

In accordance with instructions, the Yellowstone Park Division started for its field of labor on July 26, 1878, taking the field at Granger Station, Wyoming, on the Union Pacific Railroad.

At the outset the party comprised, besides myself, Dr. A. C. Peale, geologist; J. E. Mushbach and Russell West, assistant topographers; with two packers and a cook. After entering the field of work, Messrs. Peale and Mushbach were detached for special work in connection with the hot springs and geysers, while Mr. W. H. Holmes joined my party as geologist.

The route of the party to the field of work lay up the Green River Basin, following in a general way the course of Green River. At the mouth of Lead Creek we left the Green on our right and struck over in a northwesterly direction to the drainage basin of Hoback's River, a large left-hand branch of Snake River. This stream heads in the eastern slopes of the Wyoming Range, and in the southwestern slopes of the Gros Ventres Mountains, and, having accumulated its waters in a basin in the angle of these two ranges, it cuts a tremendous gorge through the former on its way to join the Snake. This cañon has been very much used by the Gros Ventres, Bannock, and Shoshone Indians as a

part of their route from the Snake River Plains to the Wind River Valley and the buffalo range, as the broad and deeply-cut trails testified. But for many years the route had been deserted, as we found large trees growing across the trails and completely obstructing them. The cañon is narrow, with precipitous walls, and in some places difficult and dangerous for pack-animals. I am inclined to believe that only war and hunting parties were in the habit of using it, as lodge-poles and the other bulky paraphernalia of an Indian village would find the passage through these defiles both difficult and dangerous in the extreme. It was through this cañon that Mr. Hunt and his companions made their way in 1811 to the banks of the Snake or "Mad" River, in their terrible journey to Astoria.

Hoback's River enters the Snake a few miles below the head of the cañon of the latter stream, but above its mouth the cañon is not at all difficult to traverse.

Turning northward, on reaching the Snake, my party followed up this stream through the broad valley known as Jackson's Hole, passed Jackson's Lake, at the head of the valley, and left the stream only at the point where the Lewis or Lake Fork joins it, at the southern boundary of the Yellowstone Park, where we arrived on August 9. Here the work began. At this point we turned westward, following up a small branch of Lewis Fork. This little stream, heading in springs at the base of Pitchstone Plateau, we left on our right, and, crossing a low divide, in a gap between the Teton Range and Pitchstone Plateau, we struck Falls River, here a good-sized stream. This river we followed down to the border of that great marshy valley known as Falls River Basin. We then skirted this valley to the point of debouchement of Bechler's Fork from the high plateau. Here we turned our backs upon Falls River Basin, climbed the plateau on the northwest side of Bechler's Fork, and followed its general course, keeping on the high plateau, near its cañon. Reaching its head, we struck over a low divide, and descended to the Shoshone Geyser Basin, on Shoshone Lake. This was on August 14. At this point I remained, detained by rainy weather, until the 21st, occupying myself in the intervals between the showers in surveying the Basin.

On the 20th I started, accompanied by a packer, on a trip to the Red Mountains for the prosecution of the topographical work in and about them, leaving the balance of the party at Shoshone Lake.

From the west end of Shoshone Lake I traveled on a direct course to the west end of the mountain group, then climbed the range at this end, and traveled along the crest to Mount Sheridan, being obliged to leave the top only once, and then for only a short distance.

On the 21st, while still in the mountains, I was joined by Mr. Holmes, and together we completed the trip, surveying the country in reach from the Red Mountains and Flat Mountain. Returning, we touched the northeast corner of Lewis Lake, crossed Lewis Fork at the outlet of Shoshone Lake, and thence skirted the latter around to camp.

Immediately after returning from this trip, on the 26th, my whole party went over to the Firehole River, and down it to the Upper Geyser Basin. Delaying there a day, we moved down to the Lower Basin, having left Messrs. Peale and Mushbach behind to carry on their work. While on this march we learned for the first time that the hostile Bannocks were in our vicinity. As the reports were very indefinite as to the extent of the danger, we decided to remain where we were until more information should reach us. Meanwhile we located our camp in

a defensible position, corraled our stock at night, and took other precautions customary under similar circumstances. As usual, definite information diminished the danger very much, and after two or three days' delay we went on. Crossing to the Yellowstone by Howard's road, we stopped two days at the Falls, then drove on down the river, and reached the Mammoth Springs, where our supplies were stored, on September 7. From that date to the 12th we were busied about that place, visiting, among other points, Sepulchre Mountain and Electric Peak.

On the 12th we started again, returning up the Yellowstone to Baronette's bridge, where we crossed it, and followed up the East Fork to a point above the mouth of Soda Butte Creek. Then leaving it, we crossed to Pelican Creek, by which and Turbid Creek we reached Yellowstone Lake. Then we followed the lake up to the head, and went several miles up the Upper Yellowstone. Returning, we followed the lake shore around to the head of the river, and thence followed the river trail down to the Mammoth Springs, reaching them on October 2.

Having refitted, we started again, this time up the Norris road, to survey the drainage areas of Gardiner's and Gibbon Rivers. We traveled up the wagon road nearly to the head of the cañon of the Gibbon, which enabled me to connect with the work done in that neighborhood earlier in the season. Then we skirted the east base of the Gallatin Range, making stations on the summits; and then, the season being far advanced, the weather being very bad, and the snow rapidly becoming deeper, I judged it best to close the work, although the whole plan had not been carried out.

We arrived finally at the Mammoth Springs on October 11, and at Bozeman, where the party disbanded, on the 16th. The whole distance traveled by my party is estimated at 830 miles. In the prosecution of my work I traveled an estimated distance of 1,250 miles.

GEOGRAPHICAL WORK.

The area assigned to me for survey during the field season of 1878 was the Yellowstone National Park, situated mainly in northwestern Wyoming, though embracing narrow strips of Idaho and Montana. The area is 3,312 square miles.

While a part of this region had been surveyed by the meander method, in 1871 and 1872, by this organization, still there were large gaps in the maps; while, in addition, the whole work required correction by the introduction of a system of triangulation. Many reconnoissances of the Park have been made, the War Department having sent no less than four distinct expeditions (of which more hereafter), but all have traversed very nearly the same routes, so that the map of any one of them is very like those of the others, differing only in matters of detail or of longitude. For this reason I have used only the earlier maps of this organization, in so far as I have used any other work than my own, in making up the general map; as I had found, experimentally, that the work of Schönborn and of Bechler was at least as good as any other which had been done in the region, and covered all the country which any of the others do.

Within the Park Mr. Wilson located three primary points—Electric Peak and Mounts Washburn and Sheridan. Starting from these, I established a large number of secondary points, distributed over the Park to as good advantage as the topographical conditions would ad-

mit, sketching the topography and correcting it by locations in the usual manner.

Owing to delays, caused by the neighborhood of hostile Indians, and by bad weather, I was unable to complete the area assigned me. The unfinished portion is in several parts, distributed about the western, southern, and eastern borders, the larger part being on the west. Altogether, possibly 500 square miles remain undone.

The general map of the Park has been plotted on a scale of one mile to an inch, and published on half that scale, *i. e.*, two miles to an inch. The contours are approximately 100 feet apart, vertically.

During the season one of my assistants, Mr. J. E. Mushbach, was employed in making minute and detailed surveys of the most important groups of springs. From his notes I have made maps of the following groups:

Name of group.	Scale of plot.	Scale of published map.
	Feet per inch.	*Feet per inch.*
Upper Geyser Basin	400	500
Lower Geyser Basin	500	800
Gibbon Geyser Basin	200	400
Mammoth Hot Springs	250	400
Shoshone Geyser Basin	100	500
Witch Creek Group	500	1600
Egeria Springs	200	266
Rustic Geyser Group	.....	100

Heights have been determined, as usual, by the cistern barometer, in connection with the vertical circle of the theodolite. Aneroids have been used very little and with the greatest caution, as they have been found to be extremely untrustworthy.

Barometrical observations have been referred, for computation of heights, to those of the United States Signal Service, at Virginia City, Mont. The height of this station was determined by the computation of a year's coincident observations at this point and Salt Lake City, Utah, giving, as a mean result for the former station, a height above Salt Lake City of 1,533 feet. The height of the barometer at Salt Lake City was determined as follows:

	Elevation in feet.
Ogden track Union Pacific and Central Pacific Railroads, Gardner*	4,303
Salt Lake City track, below Ogden track, by the Utah Central Railroad	42
Salt Lake City track, above sea	4,261
Signal office, Salt Lake City, cistern of barometer, above track, from levels by United States Signal Service	93
Signal office, Salt Lake City, cistern of barometer, above sea	4,354
Hence, Virginia City, signal service office, 1878, above sea	5,887

The sub-party, under Dr. Peale, was stationary for considerable periods, and, as a full barometrical record was kept by Mr. Mushbach, of that party, I have considered it best to treat the camps of that party as subsidiary hypsometric bases, determining their heights directly from Virginia City, and then using them for the determination of the heights of my more transient camps and stations. The heights of these subsidiary bases were determined from observations extending over intervals from one to three weeks, an interval long enough, particularly as they were quite near Virginia City in height, to establish their elevations with an approach to accuracy. Now, as all these bases are within the small area of the Park, heights determined from them can be sub-

*Annual Report U. S. Geol. Survey, 1873, p. 658.

ject to but very small errors of gradient. That the results are as good as could be expected from barometric work, the following table, comparing measurements made in 1878 and in 1872, when the conditions were not as favorable, will show:

	1872.	1878.
	Feet.	*Feet.*
Electric Peak, west summit	10,997	11,100
Mount Washburn	10,388	10,346
Camp on Elk Creek	6,236	6,436
Camp at Mud Geysers	7,712	7,725
Yellowstone Lake	7,788	7,738
Camp in Lower Geyser Basin	7,252	7,236
Shoshone Lake	7,870	7,830
Lewis Lake	7,757	7,800
Red Mountain	9,806	9,777
Mount Sheridan	10,343	10,385
Forks of Snake River	6,892	6,786
North Twin Butte	7,962	7,976

These discrepancies, which, to one accustomed to deal only with results by level, would appear enormous, are, in reality, quite within the range of ordinary barometric work in a mountainous region. Discrepancies of 200 feet between single results are not unfrequently met with, and a close accordance among three, four, or five results is a most rare accident, and suggests to one acquainted with such work anything but great accuracy in manipulation and computation. The best barometrical observer finds it impossible to set and read his instrument with certainty closer than .006 or .008 of an inch. Add to this the defects in the barometric formula and constants, which produce periodic errors of great magnitude, and which, though they can be to some extent avoided, cannot be wholly eliminated, and the great accidental errors arising from differences in barometric gradient, and it is easy to see that the barometer has no claims and can have none to being an accurate instrument. All that can be claimed is that, when used to the best possible advantage, it will give results approximating to the truth. To illustrate the range of results given by this instrument, I add, in the following lists, the measurements of a few points in the region under consideration, as made by several different observers, at different times and under different conditions.

The measurements made by Dr. Hayden's first expedition, in 1871, were made with the siphon barometer, and were computed by the aid of an assumed base of 30 inches for the barometer at the sea-level. The discrepancies between these results and my own, amounting, in some cases, to several hundreds of feet, are due to the faulty method of computation, as I demonstrated in my report on the work of 1872.

The large differences between my own results and those of Captain Jones, which, as will be noticed, average about 200 feet, and are quite constant, his results being the lowest, are not as easily accounted for. But as my results during the two years 1872 and 1878 are, within fair limits of error, the same, and as they remain the same, whether computed from Virginia City, from Salt Lake City directly, or from Cheyenne, I cannot believe that I have a constant error. Moreover, the results of Messrs. F. A. Clark, George B. Chittenden, and G. R. Bechler, who have, under this organization, during the past two years, carried on topographical surveys embracing parts of the region traversed by Captain Jones, show the same discrepancies between elevations of points determined by them and by Captain Jones. It seems fair to assume, therefore, that the burden of proof lies with the latter.

MOUNTAINS.

Names.	Range.	Latitude.	Longitude.	Elevation.
		° ′ ″	° ′ ″	*Feet.*
Mount Hancock		44 09 00	110 25 00	10,235
Mount Sheridan	Red Mountains	16 00	32 00	10,385
Mount Sheridan (Hayden, 1872)	do			10,343
Mount Sheridan (Jones, 1873)	do			10,150
Red Mountain	do	17 30	32 20	9,777
Red Mountain (Hayden, 1872)	do			9,806
3-9	do	16 00	32 20	10,320
4-9	do	16 10	32 40	10,305
5-9	do	17 10	32 50	9,742
7-9	do	16 10	33 00	10,200
8-9	do	16 00	33 30	10,144
9-9	do	15 50	33 40	10,104
10-9	do	15 10	33 30	9,698
3-13	do	16 30	34 40	9,448
26-8	do	16 20	34 50	9,627
27-8	do	16 00	35 00	9,690
Station 8	do	15 50	35 40	9,560
Mount Washburn	Washburn Mountains	48 00	26 20	10,346
Mount Washburn (Hayden, 1872)	do			10,388
Mount Washburn (Jones, 1873)	do			10,105
Station 20	do	47 30	23 50	9,692
Station 18	do	46 25	32 30	9,494
40-19	do	53 30	31 30	9,166
41-19	do	51 30	35 00	9,794
42-19	do	51 30	36 25	9,638
43-19	do	50 40	34 50	9,855
13-18	do	53 30	30 30	9,633
14-18	do	52 10	32 50	9,468
20-18	do	51 50	34 00	9,503
37-19	do	48 30	26 20	9,711
11-18	do	48 00	30 00	9,894
12-18	do	47 00	30 20	9,809
44-19	do	47 00	33 40	9,432
Dunraven Peak	do	47 00	28 30	9,988
12-19	do	47 10	27 00	9,506
13-19	do	47 30	26 30	10,001
14-19	do	47 35	26 20	10,122
15-19	do	47 50	26 00	10,270
c-20	do	47 40	25 30	9,935
Electric Peak	Gallatin Range	45 00 30	50 30	11,155
West Electric Peak	do	0 30	51 00	11,100
West Electric Peak (Hayden, 1872)	do			10,992
Sepulchre Mountain, station 25	do	44 59 40	46 00	9,737
Sepulchre Mountain, station 26	do	59 25	46 20	9,769
Cinnabar Mountain	do			7,343
Bunsen Peak	do	56 00	42 40	8,775
8-25	do	59 40	52 20	10,282
7-25	do	59 30	53 00	10,292
6-25	do	59 25	53 00	10,253
5-25	do	58 40	52 50	10,236
4-25	do	57 45	53 10	10,626
3-25	do	56 50	52 30	10,433
2-25	do	56 50	53 50	10,478
1-25	do	57 15	51 40	10,060
19-25	do	57 20	52 00	10,153
25-22	do	54 30	49 30	10,026
Quadrant Mountain	do	54 50	50 00	10,127
5-46	do	52 10	51 00	10,142
4-46	do	49 25	53 00	9,800
3-46	do	52 15	51 00	10,150
2-46	do	52 25	50 25	10,074
1-46	do	49 15	50 45	10,200
11-47	do	53 10	51 15	10,358
12-47	do	50 50	53 30	10,173
Left Madison Mountain	do	48 50	52 30	9,868
Mount Holmes	do	49 20	51 35	10,528
10-47	do			10,240
14-47	do			10,128
7-48	do	50 25	52 25	10,075
1-*d*	do	47 30	51 20	9,150
Mount Evarts	do			7,600
Emigrant Peak (*d*)	Yellowstone Range			11,034
26-25	do			10,720
Hell Roaring Mountain	do	45 00 20	26 50	8,418
1-21	do	1 20	25 15	8,040
14-21	do	1 00	25 00	8,012
Station 31	do	44 56 50	16 30	7,788
Bison Peak	do	56 50	13 25	9,038
1-30	do	57 45	9 50	9,927
2-30	do	45 00 25	6 00	10,726
3-30	do	1 00	7 00	10,364
4-30	do			9,862
2-31	do			8,906
Soda Hill	do	44 54 20	11 00	9,518

MOUNTAINS—Continued.

Names.	Range.	Latitude.	Longitude.	Elevation.
		° ′ ″	° ′ ″	*Feet.*
Index Peak	do			11,702
Baronette's Peak	do	58 30	5 00	10,459
2–33	do	54 00	4 20	10,529
3–33	do	55 30	4 40	10,332
4–33	do	53 00	5 20	10,025
Mount Norris	do	52 40	5 30	10,019
White Cañon	do	55 10	9 15	9,866
Outer Point	do	54 30	9 50	9,506
Specimen Ridge (top)	do	52 10	17 00	8,806
Station 34	do	51 10	13 30	8,703
Amethyst Mountain	do	49 40	15 00	9,423
10–36	do	48 00	2 30	9,054
Station 37	do	51 30	8 30	8,277
1–*a*	do			10,576
2–*a*	do			10,460
3–*a*	do	42 30	0 50	10,132
4–*a*	do			11,000
5–*a*	do			10,874
6–*a*	do			10,735
7–*a*	do			10,873
8–*a*	do			11,062
12–*a*	do	39 40	5 30	9,570
14–*a*	do	39 00	6 40	9,307
15–*a*	do	38 30	7 20	9,346
16–*a*	do			10,678
17–*a*	do	35 20	6 20	10,820
18–*a*	do	34 30	6 06	10,624
19–*a*	do	34 20	6 45	10,500
Pelican Hill	do	39 00	11 35	9,580
2–38	do	33 25	8 00	10,374
Mount Chittenden	do	32 50	10 30	10,190
Mount Chittenden (Jones, 1873)	do			10,027
Lake Butte	do	30 50	15 45	8,822
2–39	do	32 30	10 20	10,108
2–39 (Jones, 1873)	do			9,938
13–39	do	30 40	8 45	10,137
14–39	do	29 30	8 40	10,434
15–39	do	29 20	9 00	10,478
7–39	do			10,624
8–39	do			10,474
3–39	do	31 40	10 00	10,142
Grizzly Mountain	do	28 10	10 40	9,982
4–42	do	27 30	10 00	9,964
Smoothface Mountain, north	do	28 40	7 50	10,500
Smoothface Mountain, south	do	28 30	7 45	10,417
Station 43	do	25 30	13 40	9,078
Signal Hill	do	25 00	16 30	8,210
3–42	do	27 20	8 40	10,252
Mount Doane	do	24 45	9 00	10,713
Mount Stevenson	do	24 00	9 45	10,420
Mount Langford	do	24 25	6 30	10,779
20–44	do	23 25	4 15	10,902
22–44	do	22 40	4 10	11,155
20–41	do	23 10	11 00	9,815
21–41	do	22 25	11 30	9,704
22–41	do	21 50	11 50	9,730
20–44	do	23 15	8 00	10,507
19–44	do	22 00	8 25	10,122
Turret	do	16 15	4 05	11,142
23–44	do	18 50	6 25	10,706
24–44	do	18 40	7 35	10,389
25–44	do	17 30	6 45	10,884
26–44	do	17 50	7 00	10,919
27–44	do	17 40	8 05	9,939
28–44	do	17 20	8 40	9,519
40–44	do	13 00	3 10	10,680
17–9	Continental Divide, south of Yellowstone Lake.	15 10	23 40	9,300
19–9	do	13 00	24 25	9,700
20–9	do	11 20	23 30	9,600
Flat Mountain		21 20	26 20	9,200
Promontory Top		22 00	17 00	8,706
Elephant's Back				8,884
Garnet Hill		57 10	26 10	7,177
South Twin Butte, Lower Geyser		32 00	53 10	7,977
South Twin Butte, Lower Basin (Hayden, 1872).				7,979
North Twin Butte, Lower Basin		32 30	52 50	7,976
North Twin Butte, Lower Basin (Hayden, 1872).				7,962
Sphinx	Madison Range			10,700
Lone Mountain	do			11,136
Station 16 (high ridge north of Gibbon's Fork).		39 40	51 45	8,520

ELEVATIONS OF MISCELLANEOUS POINTS.

	Feet.
Amethyst Creek, trail crossing of	6,703
Baronette's bridge (Hayden, 1872)	5,978
Beaver Lake	7,415
Bechler's Fork, head of Fall River Basin	6,411
Bechler's Fork, at head of stream	8,191
Bechler's Fork, butte in forks of	8,451
Beulah Lake (Hayden, 1872)	7,530
Blacktail Deer Creek, crossing of lower trail	6,570
Cascade Creek, camping ground on (Hayden, 1872)	7,912
Cascade Creek, camping ground on (Jones, 1873)	7,724
Crater Hills	7,820
Divide:	
Firehole, Snake, and Henry's Fork (Hayden, 1872)	8,761
Lewis Lake to Yellowstone Lake (Hayden, 1872)	8,024
East Fork of Firehole to Yellowstone River (Hayden, 1872)	8,893
Lower Geyser Basin to Henry's Fork (Hayden, 1872)	8,267
Yellowstone to East Fork of Firehole (Hayden, 1872)	8,164
East Fork of Gardiner's River to Blacktail Deer Creek	6,887
Gardiner's River to Gibbon River	7,760
Pelican Creek to East Fork of Yellowstone	8,660
Broad Creek to East Fork of Yellowstone	8,822
Agate Creek to East Fork of Yellowstone	9,061
Firehole to Shoshone Lake, northeast corner	8,523
Shoshone Creek to Firehole River	8,245
Shoshone Geyser Basin to Bechler's Fork	8,677
Madison Lake to Bechler's Fork	8,504
East Fork Firehole to Yellowstone, on Howard Road	8,336
Snake to Falls River	7,434
East Fork of Firehole:	
Mouth of (Hayden, 1872)	7,237
At the base of the divide	7,460
East Fork, Gardiner's River:	
Foot of Gates	6,387
Top of Gates	6,587
At bend	6,850
Where the trail leaves it	6,887
East Fork of Yellowstone River:	
Mouth of	5,970
Mouth Soda Butte Creek	6,700
Elk Creek:	
Camping ground	6,436
Camping ground (Hayden, 1872)	6,236
Summit above	7,476
Falls River:	
At head Falls River Basin	6,478
Plateau east of	7,568
Flat-topped butte, in Forks of Yellowstone	6,610
Gardiner's River:	
Mouth of (Hayden, 1872)	5,360
Forks of	6,200
Geode Creek, crossing of, on trail	7,362
Gibbon Lake	7,838
Gibbon River:	
Mouth of (Hayden, 1872)	6,811
Head of cañon of	7,350
Gibbon Geyser Basin	7,527
Heart Lake	7,475
Heart Lake, Geyser Basin[a]	7,475
Hering Lake	7,530
Holmes, Mount, base of	7,885
Indian Creek:	
Mouth of	7,246
At base of Gallatin Range	7,643
Lewis Lake	7,800
Lewis Lake (Hayden, 1872)	7,757
Lower Geyser Basin	7,236
(Hayden, 1872)	7,252
(Jones, 1873, higher point)	7,162

	Feet.
Madison Lake (Hayden, 1872)	8,300
Madison River, at foot of cañon	6,605
Mammoth Hot Springs:	
At cabins	6,387
Summit above, on Norris road	7,310
Mary's Lake	8,336
Mud Geysers on Yellowstone River	7,725
Mud Geysers on Yellowstone River (Hayden, 1872)	7,712
Quadrant, Mount, base of	7,718
Riddle Lake	8,000
Salt Lake City, United States signal office [b]	4,354
Shoshone Geyser Basin	7,837
Shoshone Geyser Basin (Hayden, 1872)	7,881
Shoshone Lake	7,830
Soda Butte Creek, mouth of	6,700
Snake River, Forks of	6,786
Snake River, Forks of (Hayden, 1872)	6,892
Sulphur Springs, near Mary's Lake (Hayden, 1872)	8,246
Tower Creek:	
Mouth of	6,207
Trail crossing of	6,579
Upper Geyser Basin:	
Near Old Faithful	7,372
Near Castle	7,377
Near Castle (Hayden, 1872)	7,394
Near foot of basin (Jones, 1873)	7,373
Upper Geyser Basin, east wall of	7,645
Virginia City, Mont., United States signal office [c]	5,887
Washburn Group, Pass in, over which trail passes	8,867
West Fork Gardiner's River, head of valley on	7,300
Witch Creek, foot Red Mountains	8,310
Yellowstone Lake	7,738
(Hayden, 1872)	7,788
(Jones, 1873)	7,564
Yellowstone River:	
At Mud Geysers	7,705
Top Upper Falls	7,693
Bottom Upper Falls	7,581
Top Lower Falls	7,575
Bottom Lower Falls	7,275
Yellowstone Cañon, east side, top of, at falls	7,710
Yellowstone River:	
Mouth Tower Creek (Hayden, 1872)	6,207
Mouth East Fork (Hayden, 1872)	5,970
Mouth Gardiner's River (Hayden, 1872)	5,360

LATITUDES AND LONGITUDES OF MISCELLANEOUS POINTS.

Locality.	Latitude.	Longitude.
	° ′ ″	° ′ ″
North boundary of Park	45 01 45	
East boundary of Park		110 00 00
South boundary of Park	44 08 00	
West boundary of Park		111 06 00
Mouth of Gardiner's River	45 01 45	110 42 20
Mouth of East Fork of Yellowstone River	44 55 40	24 00
Mouth of Soda Butte Creek	52 10	11 30
Outlet of Yellowstone Lake	34 00	23 00
Mouth of Upper Yellowstone	18 30	13 00
Mouth of Barlow's Fork	7 30	31 30
Outlet of Heart Lake	15 00	27 40
Forks of Snake River	8 30	41 00
Outlet of Shoshone Lake	21 20	40 00
Outlet of Lewis Lake	16 45	38 00
Mouth of East Fork of Firehole River	35 00	50 10
Mouth of Gibbon River	38 30	52 00

HISTORY OF EXPLORATIONS IN THIS REGION.

The first authentic information regarding the great natural wonders of the Park was derived from a prospecting party under the leadership of Capt. W. W. De Lacy, who in 1863 visited the Lower Geyser Basin. Previous to this time it seems that the region was known to but a few hunters and trappers, and their tales were treated as the wildest of romancing, as, indeed, many of them were, the mind of the trapper being singularly prone to exaggeration. The earliest reference to the hot springs with which I am acquainted is in the stories of a trapper by the name of Colter (or Coulter), who accompanied Lewis and Clarke's celebrated expedition across the continent. On the return of this expedition, when below the mouth of the Yellowstone, Colter was discharged, at his own request, and immediately returned to the country above the forks of the Missouri. In this neighborhood, probably on the Jefferson, his companion, Potts, was killed by Blackfeet, and he was captured. Almost miraculously he escaped from them, and, entirely naked, made his way to a trading post on the Bighorn. After this he lived for a year or more among the Bannocks, whose range included what is now the Yellowstone Park. Either during his perilous journey after his escape from the Blackfeet or during his sojourn among the Bannocks he became acquainted with the region of the hot springs and geysers, for we find him in Missouri in 1810, telling marvellous tales of lakes of burning pitch, of land on fire, hot springs, and geysers. His stories were of course treated as travelers' tales, and "Colter's Hell" was classed with Lilliput, Symmes's Hole, and other inventions of over-developed imaginations.

Later we find the knowledge of this country more generally diffused among this people. Colonel Raynolds, in his report on the "Exploration of the Yellowstone," in 1859–'60, refers to "some of these Munchausen tales" as follows (p. 77):

> One was to this effect: In many parts of the country petrifactions and fossils are very numerous, and as a consequence it was claimed that in some locality (I was not able to fix it definitely) a large tract of sage is perfectly petrified, with all the leaves and branches in perfect condition, the general appearance of the plain being *unlike* (like?) that of the rest of the country; *but all is stone;* while the rabbits, sage hens, and other animals usually found in such localities are still there, perfectly petrified, and as natural as when they were living; and, more wonderful still, the petrified bushes bear the most wonderful fruit; diamonds, rubies, sapphires, emeralds, etc., etc., as large as black walnuts, are found in abundance.

This story, absurd as it sounds, has a large basis in fact. The narrator, however, had mixed up distinct phenomena, and over all had spread lavishly the coloring of his imagination. There are fields of sage, as well as bits of forest, which, lying in immediate proximity to groups of springs, have been petrified while standing. The hot silicious water from the springs is drawn up through the pores of the wood, and between the wood and the bark, by capillary attraction, and, depositing silica wherever it goes, the tree or bush is rapidly transformed into rock.

The story of the remarkable fruit borne by these stone trees is not far from correct, the main difference between the story and the fact being that the fruit is borne on the outside and inside of the trunks of the trees, instead of on the ends of the branches. The mineral species are not as given in the story, either, but that is a matter of no vital importance. In the process of silicification of wood the last result of all is the production of quartz crystals. The tree trunk is converted totally into crystalline quartz, radiating from within outwards, the crystals being all crowded out of shape. The inside and outside of the hollow cylinder

of quartz which represents the former tree are covered with the characteristic quartz pyramids. Such products of silification are very abundant in the Park, particularly on Amethyst Ridge, and are undoubtedly the "stone fruit" of the petrified trees and bushes. The crystals are colorless, amethystine, or yellow, and according to the color are known to the mountain man as diamond, amethyst, topaz, &c.

It is unnecessary to say that the part of the story relating to animal life was manufactured from whole cloth.

The other story, in its main fact, is undoubtedly true. Many streams which at their heads are icy cold become lower down in their courses warm, or even hot. Bridger, however, attempted to account for this phenomenon without an adequate knowledge of the facts in the case. The cause of the heating of the water was not friction, due to its rapid descent, but the large accessions of hot water from springs situated along its course.

Many other similar legends had long been current among mountain men, some of which are briefly referred to in Colonel Norris's report to the Secretary of the Interior for 1878, but none of them seem to have attracted any attention. That white men have been in the Park prior to any printed record is evidenced by the discovery by Colonel Norris, as noted in his report above referred to, of a block-house near the Grand Cañon, of a caché of marten traps near Obsidian Cañon, and other relics of the early trappers.

In Mullan's "Military Road Report," 1863, pp. 19 and 53, mention is made of hot springs and geysers at the head of the Yellowstone, as if they were well known at that time.

In 1863 Capt. W. W. De Lacy, in command of a large party of prospectors, left Montana to prospect on the upper waters of the Snake. Striking that river near the junction of Henry's Fork, they followed up the main river through the cañon, prospected in Jackson's Hole, and not finding gold in paying quantities they broke up the party, some returning one way, some another. Captain De Lacy, with a portion of the party, followed up the Snake and Lewis Fork, discovering Lewis and Shoshone (De Lacy's) Lakes, the Shoshone and the Lower Geyser Basins.

Mention of this trip was made in Raymond's Report on Mineral Resources for 1869, and in 1876 the narrative was published in full in "Contributions of the Historical Society of Montana."

The geographical work done by Captain De Lacy on this trip was embodied in a map of Montana, drawn by him and published by authority of the Territory in 1864–'65, and the material thus made public was afterward used by the public land office and the Messrs. Colton, of New York, in the compilation of maps of that region.

The results of this trip, however, seem to have attracted little or no attention, for we hear of no one going into the country until 1869, when two prospectors, Cook and Folsom, made a prospecting tour through the Park. They followed the Yellowstone up to the mouth of the East Fork, then up the latter stream for a few miles, crossing over to the Yellowstone at the Great Falls; thence they went up this stream to the foot of the lake and around the west side of the latter to the extremity of the west arm, thence crossing over to the Geyser Basins on the Madison, and finally left the country by following down the Madison River. Their story immediately attracted attention, and the following summer a large party, composed of citizens of Montana, under the leadership of General Washburn, then surveyor-general of Montana, was

made up for the purpose of exploring this region. A small escort from Fort Ellis, in charge of Lieut. G. C. Doane, accompanied them.

This party made quite extensive explorations on the Yellowstone and Madison Rivers. Passing up the Yellowstone by the well-known trail, they travelled completely around the lake, visiting all localities of interest along the route, with the single exception of the Mammoth Hot Springs on Gardiner's River. While near the head of the lake, Mr. Evarts, a member of the party, became separated from the others and completely lost. After suffering untold hardships from hunger and cold, rendering him temporarily insane, this gentleman was at last found near the Mammoth Hot Springs.

The story of this expedition was graphically told by Mr. N. P. Langford, one of the members of the party, in the pages of Scribner's Monthly Magazine; while Lieutenant Doane, commanding the escort, furnished a brief report accompanied by a map of the route. The following year, 1871, Captains Barlow and Heep, U. S. A., made a reconnaissance of this country, and presented the results in a brief report and a map of their route.

In the same year Dr. Hayden devoted a portion of the season to a reconnaissance of this region, making quite an extended tour through it. The results of this work, including geological reports, maps, &c., were published in the annual report for that year. This was sufficient to fix the public attention upon this great collection of natural wonders, and when Dr. Hayden presented to Congress a proposition to reserve this section from settlement as a National Park it was adopted with little opposition.

The following year, 1872, Dr. Hayden continued the reconnaissance of the Park and the country to the north and south of it, publishing the results in the report of that year, and in a series of maps.

This region has, ever since its discovery, proved an attractive field for exploration, and scarcely a year has passed that some party, under more or less of official sanction, has not traversed it, nominally at least, for purposes of exploration.

In 1873 Capt. W. A. Jones, U. S. A., took a large party through it. He entered it from the head of the Stinking Water, crossing one of the many passes near Mount Chittenden (it is impossible to tell which). After visiting most of the points of interest in the Park he went out via the Upper Yellowstone, on the way verifying the old trappers' legend about the "Two Ocean River," and discovering a practicable pass (Togwotee Pass) and route from the south to the Park. This discovery was by far the most valuable result of the expedition.

In 1875 Capt. William Ludlow, U. S. A., in charge of a reconnaissance in Central Montana, made a flying trip to the Park. He developed little that was new save accurate measurements of the Upper and Lower Falls of the Yellowstone, quoted elsewhere.

YELLOWSTONE NATIONAL PARK.

BOUNDARIES.

According to the law by which the Yellowstone National Park was created, its boundaries were established as follows: The northern boundary is on the parallel which passes through the mouth of Gardiner's River. This point, which I have established as accurately as possible, is just 2 miles north of the parallel of 45° north latitude, which is the northern boundary of Wyoming. The eastern boundary

is on the meridian 10 miles east of the most easterly point of Yellowstone Lake. This point is at the upper extremity of the southeast arm, near the mouth of the Upper Yellowstone. Here the shore of the lake is a marsh, extending at the time of high water to the base of the Yellowstone Range, while at seasons of low water it retreats between 1 and 2 miles to the westward. Hence, the eastern boundary, as at present established, is a very uncertain affair. This line, however, cannot, under any construction of the law, be more than a mile from the 110th meridian west of Greenwich, and on my map of the Park I have taken the liberty of placing the eastern boundary on this meridian.

The southern boundary is, for the same reason, equally uncertain. Its position according to the law is 10 miles south of the southern point of the same lake. On the map, I have represented it as dating from the southern extremity (the head of the southern arm) at the time when the survey was made, *i. e.*, September, 1878.

The west boundary is 15 miles west of the western end of Madison (*sic*) Lake. At the time the law was made, the lake now called Shoshone Lake, and known to be one of the sources of Snake River, was supposed to be the source of Madison River, and was accordingly called Madison Lake. This brings the west boundary line but 2 miles west of the western boundary of Wyoming.

Now that the true relations of the Park with reference to the adjacent Territories are known, it would be much better, on many accounts, to subject its boundary lines to slight changes in order to make them conform to Territorial boundaries and to certain parallels and meridians, especially as this can easily be done at present without interference with private claims, and without throwing outside of the Park any of its matchless wonders.

The changes which I would propose are as follows: That the northern boundary be made coincident with the northern boundary of Wyoming. This would be equivalent to moving this line southward 2 miles. The Mammoth Hot Springs are 4 miles south of the Park boundary, and therefore, after this change, will remain 2 miles within the Park. The eastern boundary should be placed on the meridian of 110° west of Greenwich, or it might even be placed on the meridian of 33° west of Washington, 2.5 miles farther west, without injuring the Park as a wonderland, as in either case the line traverses a heavy and rugged mountain range. The southern boundary should be placed upon the parallel of 44°10′, thus acquiring a definiteness of position. This change would require that the line be moved north for about 2 miles.

The western boundary should be made coincident with the western boundary of Wyoming, thus throwing it 2 miles farther east. Both lines traverse for the most part a high, rugged, heavily-timbered table land, utterly valueless for any purpose except for the timber which it supports.

By these changes the whole area of the Park will be thrown into Wyoming, thus avoiding all questions as to jurisdiction of territorial government. Again, a great saving will be effected in the survey of boundary lines, as the northern and western lines have already been established, while the southern and eastern boundaries, which are very poorly defined by the law, will be definitely established.

The area of the Park, as at present established, is 3,312 square miles. Its length north and south is 61.8 and its mean breadth 53.6 miles. By the proposed change its length will be reduced to 57.5 and its mean breadth to 49.5 miles, while its area will be reduced to 2,846 square miles.

TOPOGRAPHY.

Heading the Southern Fork of the Columbia and the greater part of the drainage of the Missouri, it lies very high compared to the average of the country thereabouts. Its mean height is not far from 8,000 feet above sea-level. The lowest point in the Park—the mouth of Gardiner's River—is 5,360 feet, while the highest mountain peak—Electric—is 11,155 feet above sea.

The surface is largely made up of level or rolling country, plateau-like in character and heavily timbered. In this plateau many of the streams have cut tremendous gorges. Several groups of mountains diversify the surface, as the Red Mountains and the Washburn group. In the northwest corner rises the Gallatin Range, which separates the Yellowstone from the Gallatin River, and which culminates in the magnificent mountain known as Electric Peak. East of the Yellowstone River and Lake rises a very high and rugged range, which stretches from Union Pass north to the bend of the Yellowstone, a range to which Dr. Hayden has given the name of the Yellowstone Range, and which subsequently Capt. W. A. Jones called the Sierra Shoshone. The southern section of the Park is drained by the various affluents of Snake River, Bechler's Fork, Falls River, Lewis Fork, and Barlow's Fork. This drainage area comprises 682 square miles. It is made up mainly of plateaus, and of high rolling country, most of which is densely timbered.

BECHLER'S FORK.

This stream, named from its discoverer, Mr. G. R. Bechler, at that time topographer of one of the parties of this survey, heads opposite the head of the Madison or Firehole River and Shoshone Lake, being separated from them by narrow, abrupt divides of no great height. Its head and most of its course are through a high volcanic plateau, and for most of its course it is sunken far below the general level in a deep, rugged cañon. The plateau is well timbered with the larger coniferæ. Falls River Basin, into which this stream debouches abruptly, the plateau ending suddenly in a line of cliffs facing to the westward, is a large valley, part of which is open, while a part is covered with a dense growth of large coniferæ, and the ground is cumbered with fallen timber to such an extent that, added to the swampy, springy nature of the soil, the Basin is wellnigh impassable. Of the extent of the Basin I cannot speak, as it extends far to the west and north of the limits of my work. Into it flow several large streams. Besides Bechler's Fork, Falls River, Cascade Creek, and a large northern branch of Falls River enter this basin. This valley has but very little slope, and the streams which enter it are immediately split into a number of channels, with many slues and back-waters, which are interlaced with one another in a complex network. It contains also many stagnant pools and ponds, and multitudes of springs break forth from the base of the limiting cliffs. It is one of the few remaining haunts of the moose in the Northwest.

FALLS RIVER.

This stream heads in the southern slopes of the great plateau which Bechler's Fork traverses, rising in four large springs, which give birth immediately to a good-sized river. Its course is nearly due west, skirting the southern base of this plateau. The divide between this stream and the Snake is very gentle, being, indeed, almost imperceptible. Its

course from the divide to the Lakes Beulah and Hering is very quiet, with a gentle current through grassy meadows, but from the point of its emergence from the former of these lakes, it becomes a brawling, turbulent stream, broken by cataracts and falls, from which it has received its name. These falls, which succeed one another at short intervals, have heights respectively of 12, 6, 12, 40, 20, and 30 feet. Finally, at a point but three or four miles above where the stream debouches into Falls River Basin, occur the Great Falls. These, which are close together, consist of two, each having a clear leap of over 20 feet, closely followed by a third of 47 feet, below which are two smaller ones. The total descent is 140 feet, my measurements agreeing very closely with those of Professor Bradley.*

SNAKE RIVER.

At the south boundary of the Park the Snake divides into two branches, the eastern one of which continues to bear the name of the main stream, while the other, which heads in Shoshone Lake, bears the name of Lewis or Lake Fork. The former stream, which is somewhat the larger of the two, heads in several large branches among high hills and mountains to the eastward. The ultimate head of the main branch is southeast of the Forks, among the mountains on the course of Buffalo Fork of the Snake, in a section of country not yet surveyed. Another, known as Barlow's Fork, heads among the high, timbered hills south of Yellowstone Lake, while another, Heart River, heads in Heart Lake at the base of the Red Mountains. The courses of all these streams are in narrow, cañon-like valleys, closely hemmed in by the mountains.

Heart Lake, the head of one of the principal branches of the Snake, is a beautiful little gem, lying amid dense forests at the eastern base of Mount Sheridan, the highest peak of the Red Mountains. It is about 3 miles long by 1½ in width, covers 3 square miles, and is of a very irregular shape, the resemblance in form to a heart being very slight.

The lake has several small tributaries, most of them from the north and west. One of the principal of them, called Witch Creek, heads in Red Mountain and enters the lake near the northwestern corner. On this creek, extending over most of its course, a distance of 3 miles, is a large collection of hot springs, with a few geysers. This group has been named the Heart Lake Basin. They were probably first discovered by Mr. Evarts, while lost from the Washburn party, in which case Heart Lake is his Lake Bessie. But as they were, with the lake and other surroundings, first mapped with an approach to accuracy by Captains Barlow and Heap, in 1871, the names given by them should stand. From the southeast corner of this lake Heart River flows southward, uniting, after a course of five miles, with Barlow's Fork. The combined streams then pursue a devious course to the southward for a few miles, then, joined on the south boundary of the Park by the Snake, they turn northwest, and finally southwest, towards the Forks. South of the Snake and Barlow's Fork the country rises very rapidly to mountains 9,000 feet in height, standing in meridional ridges, across the north ends of which the river has cut a passage. On the north is a high, trachyte-covered plateau, rising gradually towards the Red Mountains.

* Report U. S. Geol. Survey for 1872, p. 258.

LEWIS OR LAKE FORK.

This stream rises in Shoshone Lake, opposite the heads of the Firehole and Bechler's Fork. Leaving Shoshone Lake, it flows into and through Lewis Lake, then, pursuing a straight course a little west of south, it reaches and joins the main river, at the south line of the Park.

Shoshone Lake is purse-shaped, but, unlike most purses, its point of discharge is at the bottom of the larger lobe. Its greatest length is 6½ miles, its greatest width 4½, while the stricture is but ½ mile across, and its area is 12 square miles. It receives three small affluents, Moose Creek near its foot, Shoshone Creek at its head, and an unnamed stream at the northern end of the lower lobe. Besides these there are a number of small branches, but collectively they contribute very little to the lake. At the head of the smaller and upper lobe of the lake, *i. e.*, at its western end, is a collection of hot springs and geysers, discovered by one of the parties of this survey in 1872, and known as the Shoshone Geyser Basin.

The shore of the lake is almost everywhere bold and densely covered with timber. The stream connecting Shoshone and Lewis Lakes is but 3 miles in length, and is broad and sluggish. Lewis Lake is nearly pear-shaped, the outlet being at the stem end. It is 3 miles long by 2 in width, with an area of 4 square miles, with bold, heavily timbered shores. Besides the main stream, the lake receives very little water from the gulches opening into it.

On leaving Lewis Lake, the stream first passes the western end of the Red Mountains, then enters an inclined table-land floored with basalt, in which the stream has cut a narrow, deep rift, scarcely discernible at any distance, which extends nearly or quite down to the Forks. As I did not follow the stream in this portion of its course, I quote the following description of it from Professor Bradley's report:*

> In descending from Lake Lewis, the party found the river banks low and rocky for a short distance before the stream enters a cañon with walls 150 to 200 feet high, in which were encountered sharp rapids and a vertical fall of about 30 feet. Then, for a mile or two, the slopes are gradual, with narrow, swampy bottoms along the river. About three miles below the lake, high, rocky banks indicate the approach to a deep cañon, which really commences at about 3½ miles, with perpendicular walls on both sides, inclosing a narrow channel with a rapidly-sloping rocky floor, in some places partially obstructed by huge tumbling masses of rock, but apparently without any accumulation of gravel. Considerable rapids occur through nearly the whole cañon, and one fall of nearly 50 feet was noticed. The cañon deepens rapidly to from 700 to 800 feet, with widths of less than half the depths at the deepest precipitous portions, though in some places widening above, so as to have sloping banks at an angle of about 59° from the horizon. About 3 miles down it reaches its culmination and is truly grand. It has none of the brilliancy of coloring so characteristic of the Yellowstone cañon, but the somber tints of its gray, brown, and dark red, lichen-covered rocks, variegated with smaller patches of green and yellow, constitute a peculiar style of beauty, and add greatly to the effect of its narrow, dark depths. The only deficiency is in the supply of water, which is small at this season. The rocks are all volcanic, mostly porphyries and trachytes, with some porphyritic obsidian. Some two miles below the end of the main cañon, the cliffs close in again to the river, for a few hundred feet, for a width of about 200 feet, with a height of 400 feet or more, forming a suitable gateway to the cañon from below.

THE RED MOUNTAINS.

This is a small group of mountains, standing between Barlow's and Lewis' Forks, and rising to a height a little exceeding 10,000 feet. The name is derived from the prevailing color of the volcanic rocks which compose them. The slight indication of a trend which they exhibit is

* Report U. S. Geol. Survey. 1872; pp. 256, 257.

nearly east and west. They are by no means rugged, though many of the slopes are extremely steep. There are twelve peaks in the range, separated into three groups by comparatively low saddles. The highest and most eastern peak is Mount Sheridan, 10,385 feet high. From its summit a most varied, extensive, and beautiful landscape rewards one for the hard climb involved in reaching it. On the west the range of vision is limited by a high plateau, in whose southern slopes head Falls River and a small branch of Lewis Fork. To this plateau we have given the name of Pitchstone Plateau. At the eastern base of this the eye can with difficulty discern the narrow cleft in the basalt in which flows Lewis Fork, running transversely to the line of vision. Farther to the right, at the northern base of Pitchstone Plateau, we see the sparkling waters of Shoshone Lake reflecting the afternoon sun. Approaching the foreground, a broad ribbon of water connects this with Lewis Lake, beautifully set in a dark fringe of dense forest. Beyond these lakes, nearly to the horizon, is an almost unbroken, billowy surface of dark, blackish-green forests, while the horizon line is marked by the sharp, snowy peaks of the Madison Mountains. Farther around is the broad, flat, hardly perceptible swell of the continental divide, densely timbered and dotted with little lakelets. Next appears the western edge of the Yellowstone Lake, whose irregular shape, with long arms, reaching far inland, occupies more than a quarter of the circle of the field of view. Beyond it, to the north, rises the plateau of the Elephant's Back, surmounted, apparently, by the peaks of the Washburn group of mountains. On the northeast, far in the distance, and scarcely discernible against the intense blue of the sky, are the rugged, precipitous peaks of the Yellowstone Range, which, as we turn more to the east, approach the lake, which finally laps the very feet of the highest peaks.

In the foreground, between our mountain and Yellowstone Lake, is a great area covered densely with forests, and broken into great bulky hills.

Southward the view is more limited, being cut off by the confused mass of mountains at the head and on the south side of the Snake. Slightly to the west of south, however, the sharp, lofty spires of the Tétons rise high above the mountain ridge which forms the eastern wall of the Snake River Valley. Thence the eye follows the outline of the Téton range as it trends northward. The needle-like spires change to broader and more massive forms, while the range at the same time decreases in altitude. The timber line gradually nears the summits, then the mountains are covered with forests as the range becomes lower, until finally it terminates in a low gap, by which we pass to the head of Falls River, on the north of which rises Pitchstone Plateau. An unusually clear day discloses many more mountains than have been enumerated here. Professor Bradley counted, from this mountain, 471 distinct peaks, at distances ranging from 30 to 200 miles.

This range is timbered almost to the summits, though the trees near the summits, especially if at all exposed to the severe westerly blasts of winter, are stunted and beaten down. Nearly all of the higher summits are entirely bare of timber, owing, probably, to their exposed position, as the limit of timber is, in this neighborhood, slightly higher than these peaks, or, inround numbers, 10,500 feet above sea.

THE CONTINENTAL WATERSHED.

The continental divide crosses the Park in its southwestern part, having a very winding course, but a general direction nearly southeast

and northwest. Throughout, its character is broad, flat, and ill-defined. It enters the Park on the west, on an elevated plateau west of the Lower Geyser Basin, a plateau of volcanic rock, densely covered with timber, and cut by numerous abrupt cañons, but nearly destitute of water. Along this plateau the divide trends very nearly south. Reaching the heads of the Firehole and of Bechler's Fork, it turns to the east and then to the north, to pass around the head of Shoshone Creek. Here it changes its character, and becomes a rather sharp ridge, the sides of which are deeply cut by small gulches, producing an endless amount of small detail in the topography. North of the eastern part of Shoshone Lake the divide again makes a decided change in direction, returning almost upon itself, and thence runs in a general southeast direction across the remainder of the Park, leaving it at a point south of the south arm of Yellowstone Lake. From the turning point down to Flat Mountain, the divide is somewhere on a broad, rolling swell, the highest point of which is but slightly above Yellowstone Lake. Over a breadth of several miles there is scarcely any perceptible slope, and the broad swell is dotted with lakelets and marshes having no outlets. From the north, the elevation of this portion of the divide decreases southward, reaching its lowest point near Lake Riddle, a lakelet without outlet, at an elevation of 8,000 feet above the sea. This name like the "Great American Desert," has been driven from point to point, finding, like the Wandering Jew, no abiding place, until finally Professor Bradley rescued it from its peripatetic career, attaching it to this insignificant lakelet, where it is not likely ever to be disturbed. Among its past glories, it is to be recorded that on many maps what we now know as Yellowstone Lake appears as Lake Riddle. Flat Mountain, which next bears the main watershed, is, as the name implies, flat. Its broad-timbered summit covers several square miles, while its slopes, which on all sides but the north are very gentle, make the mountain cover a large area of country. The northern slopes, at the base of which lies the Flat Mountain arm of Yellowstone Lake, are rugged and precipitous. By some of the earlier expeditions, *e. g.*, Doane's, 1870, and Barlow & Heep's, 1871, this mountain was called Yellow Mountain from the color of the volcanic rocks on the north face. This name, however, seems to have fallen into disuse.

Southeast of Flat Mountain, the divide follows the crest of a range of rounded hills, timbered to the summits, which carry the watershed outside of the Park.

THE YELLOWSTONE DRAINAGE AREA.

The Yellowstone River heads in Bridger Lake, southeast of the Park, and in the mountains in its neighborhood. One of the forks of the well-known "Two Ocean Creek" also contributes to it. This part of the stream, above Yellowstone Lake, is commonly known as the Upper Yellowstone River. Its course is slightly west of north, in a valley averaging about 2 miles in width, sharply defined by mountain walls which rise abruptly on each side to great heights. The eastern wall is the rugged, volcanic Yellowstone Range, whose peaks reach altitudes exceeding 11,000 feet; while on the west there is an abrupt descent to the valley of a high undulating country, approaching a plateau in character, and of a height of 9,000 to 10,000 feet. The stream is sluggish, and much of the valley, especially in the lower part, is very marshy, so as to be practically impassable. Throughout, it is densely timbered.

The drainage area of this system comprises more than half the area of the Park, being 1,900 square miles.

YELLOWSTONE LAKE.

In one essential respect the scenery of the Yellowstone Park differs from that of nearly all other parts of the Cordilleras, in possessing the element of beauty, in presenting to the eye rounded forms, and soft, bright, gay coloring. The type of Cordilleran scenery is grand, awful, dull with even a touch of the repulsive. The prevailing colors, gray and brown, weary the eye by their uniformity. Water, which forms so essential an accessory to a beautiful landscape, is, in the West, usually wanting. Here, however, the country is dotted with lakes, great and small, while the comparatively moist climate has prevented rapid erosion by keeping the land well clothed with forests, and thus preserving rounded forms.

Among these lakes, Yellowstone is the largest and by far the most important. It is the largest lake, at a great elevation, in North America. It has an extremely irregular outline. It has been likened to the human hand, with the fingers outstretched, and, with certain amendments, this simile may serve for purposes of description. The western arm may be represented by the thumb, if we suppose the thumb so telescoped that its thickness greatly exceeds its length. Delusion Lake may represent the forefinger, detached, separated from the hand by one-third of its length, and shriveled to one-tenth its normal size. The Flat Mountain arm corresponds in position, but in no other respect, to the middle finger. It, too, supposes a miraculous degree of shrinkage. The south arm has the position of the third finger, and requires little or no change to make the likeness good; while the southeast arm, into which flows the Upper Yellowstone, must represent the little finger. This, on the supposition that the hand is that of a base-ball player, and has been hardly used, may support the simile. The upper joint has evidently been bent over and the whole upper part of the finger badly swollen; indeed, the whole finger is considerably swollen, as it is evidently the largest of all.

The length of the lake from the head of the southeast arm to the foot of the lake, a direction nearly northwest, is 20 miles, and its breadth, from its eastern shore, in a westerly direction to the head of the west arm, is 15 miles. Its area is 150 square miles. It contains a number of small islands: Stevenson's, near its foot; Dot and Frank's in the middle, if so irregular a lake can be said to have a middle; Mollie Island and a small companion, near the head of the southeast arm; Peale's Island and a companion, in a corresponding position in the south arm; Carrington's in the west arm, and a rock known as Pelican Roost, just off Steamboat Point.

The lake was sounded on a number of lines by Mr. James Stevenson, in 1871, giving a very good idea of its depths. The results of these soundings have been transferred to the accompanying map.

The shores of the lake are nearly everywhere densely wooded with a large, fine growth of coniferæ. In some places the live growth stands above and among a cobwork of fallen timber, placed like an abattis of Dame Nature to prevent man's trespassing. The slopes to the lake are for the most part gentle, easy descents, with a mud or pebble beach. Such they are from the outlet to the head of the south arm, broken only in two or three places by bluff or rocky points. The broad projection between the west and Flat Mountain arms is very low, but little above the level of the lake, and very marshy, being dotted, especially at times of high water, with many ponds. Of these, the largest, and, indeed, almost the only permanent one, is Delusion Lake, so long supposed to be an arm of Yellowstone Lake. Indeed, there is no certainty

that in the spring time, when the Yellowstone range and all the high country thereabouts is disgorging its winter accumulations of snow, this lake does not have a broad water connection with the larger lake; in other words, it may for a short time be the fore finger.

Flat Mountain makes a most decided break in the uniformity of the slope of the shore-line. The mountain rises 500 feet above the lake, and all this height is represented by a precipitous, rocky slope from the summit to the margin of the water. On the east, however, Flat Mountain slopes uniformly and gently down to the shore of the south arm. Flat Mountain arm has a length of 3 miles, with a mean width of less than half a mile. The corresponding dimensions of the south arm are 8 miles and 2½. Between the south and southeast arms is a long, narrow projection known as the Promontory. From a low isthmus, but little above the lake near the head of these deep bays, it rises to a height of 1,000 feet above the lake, at the same time broadening from 1 mile to 2. It ends abruptly in a rocky precipice facing to the north.

The head of the southeast arm is in part limited by a steep wall, the same which borders the valley of the Upper Yellowstone on the west, and in part by this marshy valley. The border of the lake is here very ill defined, the marsh extending inland for at least 2 miles to the eastward from the clear water of the lake.

Proceeding down the eastern shore of the lake we find a succession of valleys, opening out on the shore and mountain spurs, terminating abruptly at the water's edge.

Beaverdam Creek is a large mountain stream, occupying the first of these valleys, and entering the lake very near the head of the southeast arm. Three miles above its mouth, just within the mountains, it receives a large branch from the right, known as Rocky Creek.

North of this stream, a heavy mountain spur, headed by the fine peaks Langford, Doane, and Stevenson, and bearing many minor summits, reaches from the crest of the Yellowstone range to the shore of the lake. Then follows a broad valley, drained mainly by Milky Creek, north of which is the spur known as the Signal Hills. Then succeeds a third valley, in which are three creeks of considerable size, all heading in the mountains, besides several smaller ones heading in springs and swamps in the dense forest. There follows then a third spur from the mountains, terminating on the border of the lake with a round-topped hill, which I have named Lake Butte.

Next we come to the valley of Turbid Creek, on whose lower course, near the lake-shore, is quite a large collection of hot springs. This stream heads in the mountains about Mount Chittenden, and flows through Turbid Lake, a small body of water which is rendered milky from the numerous sulphur springs which dot its shore.

Beyond the mouth of Turbid Creek the lake shore runs out in a bluff point, named from a spring on the extreme point, Steamboat Point. Passing this point we see the shore retreating in smooth, graceful curves, making Mary's Bay. A mile east of this the lake receives its largest affluent, next to the Upper Yellowstone, in the form of Pelican Creek. This stream heads among high timbered hills to the northeast, against the East Fork of the Yellowstone. Comparatively little of its water comes from the high mountains of the Yellowstone range, its drainage area comprising little more than the foot-hills. It heads in three large branches, two coming from the north and the third from the east, the three uniting within a hundred yards of one another. A fourth large branch, Lake Fork, coming from the north, joins the stream about a mile below the forks. The lower course of the stream is very sluggish

and marshy; the forests which are almost omnipresent in the Park are here wanting, the broad valley being open and almost entirely devoid of timber. At its mouth the swamps develop at times of high water into a small lake or lagoon. Between the lower course of this stream and the head of the Yellowstone proper, a low ridge runs out from the high hills to the northward to the lake.

Besides the streams above mentioned, the lake receives no large affluents, though a number of small streams empty into it on the west and south. Bridge Creek, so named from a natural bridge which spans it, is a small stream which comes in from the west, some four miles south of the outlet. Besides this a stream about the same size comes in about a mile farther north. On the northern shore of the west arm a good-sized creek comes in, and on the western shore the lake receives four or five small streams. A small creek comes into the head of Flat Mountain arm, and the south arm also receives several small streams. The southeast arm receives, besides the Upper Yellowstone and Elk Trail Creek, a small stream which flows along the west edge of the valley of the Upper Yellowstone, draining the hills on the western side for a distance of 6 or 7 miles from the lake; also a second stream from these hills, which has its course west of the latter.

THE YELLOWSTONE RIVER.

This river, the largest and most important branch of the Missouri, issues from the lake at its northern end, and for 105 miles holds a generally northern course. At the mouth of Shields' River, near the site of the old Crow Agency, it turns east, and after holding this course for several hundred miles, it again turns to the northeast and continues in this direction to its junction with the Missouri at Fort Union.

From its point of exit from the lake nearly down to the Upper Falls, the river is broad and sluggish, full of aquatic plants, and frequented by large flocks of ducks, geese, and other aquatic birds. The gentle, easy current is broken only in a few places by slight rapids which afford easy and safe fords. The immediate valley varies much in width, but is for the most part narrow. On the right (east) the country rises quite rapidly at first, to a mass of flat-topped hills, in which head Sour Creek, a branch of the Yellowstone, and several branches of Pelican Creek. On the left the topography is more decided. A heavy, broad, plateau-like ridge, known as Elephant's Back, abuts against the river just below its exit from the lake. This ridge at first trends westward for 6 or 7 miles, with an elevation of 8,800 feet, separating the drainage of the lake from that of the river. Then it gradually sweeps around to the north, and becomes the watershed between the East Fork of the Fire-hole and Alum Creek, an important branch of the Yellowstone. This ridge finally fades out in the high plateau region about the heads of the latter stream and Gibbon River, after sending a long spur down to the Yellowstone River, forming the northern watershed of Alum Creek. The space inclosed by the semicircular ridge just described and the river, drained by Alum Creek and other smaller branches of the Yellowstone, is elevated but little above the level of the lake, and was formerly occupied by it. It is an oasis of open country, covered with grasses and artemesia, amid a wilderness of forest.

At the head of Alum Creek, on the summit of the divide, is a large collection of hot sulphur springs, the waters of which have collected at the foot of the springs into a pond, which feeds the creek. Another extensive group of springs occurs on a small branch of this creek, at

the base of the ridge. These springs are, from the color of their deposits, known as the Violet Springs, and the branch which they supply with water is known as Violet Creek.

A short distance above the mouth of Alum and Sour Creeks, which join the Yellowstone very close together, are the Crater Hills, on and about which are very fine hot sulphur springs, while all about, covering several square miles, the country is encrusted with their deposits.

About a mile above the Upper Fall the river breaks into rapids, then into a succession of lively cascades before rushing over the cliff at the Upper Fall. At the crest of the fall the river is contracted to a width of about 80 feet, and is shot out to a considerable distance, so that in all probability there is an abundance of room to pass under the fall.

The Lower Fall is about half a mile below the Upper, the current of the river between them being quite rapid. At the brink the river is 100 feet wide, with an unknown depth. I shall not burden the reader with an extended description of these falls, which have been amply illustrated by the reports of others.

This year I was enabled to make careful, direct measurements of them by means of cords, and have obtained results which may be depended upon. The Upper Fall was measured by dropping a weighted line from the top of the overhanging cliff immediately adjoining the fall, to the level of the water at its base, thus obtaining as correct a measurement as could be desired. This measurement gave 112 feet as the clear height of the fall.* This result, as compared with the height (140 feet) which I obtained in 1872 from barometric measurement, simply gives another illustration of the uncertainty attending such work, even when made under the most favorable circumstances. In this and in other similar cases, the fact that the height as measured by barometer is greater than the true height, it seems to me, may be explained by the downward rush of air at the lower station, which, of course, would produce an abnormal pressure at that point.

My measurement of the Lower Fall was not as simple in method, and allows more room for error than in the case of the Upper Fall. I found a point, by means of the clinometer, on the eastern wall of the cañon and very near the fall, at the same level as its top. Thence I stretched the line down the cañon wall to the level of the foot of the fall, reaching it at a point so close that we received a thorough drenching from the spray. Then, with a clinometer, I measured as accurately as possible the angle of inclination of the line. This gave as the height 297 feet. Though this result cannot be regarded as strictly accurate, still its error must be small; and in round numbers, 300 feet may be regarded as a close approximation to the true height. Ludlow measured this fall directly by means of a sounding line, obtaining 310 feet as the height, a result agreeing quite closely with mine, especially when one reflects on the difficulty of determining when the weight was at the base of the fall, in the cloud of mist and the rushing river. Most of the other measurements are barometric. Such was that of Captain Jones, who gave a height of 328.7 feet.

The measurement made by Mr. N. P. Langford in 1870, and first published in the report of Lieutenant Doane, gave a height of 350 feet to this fall. It was made with a line stretched on an incline, but there was no way of measuring with any approach to accuracy the angle of the

* Captain Jones, in 1873, by barometric measurement, found this fall 150.2 feet high; while Lieutenant Doane, in 1870, by a line, found a height of 115 feet; and Ludlow, by the same method, 110 feet; the last two of which agree very closely with my own.

Divide Lake, between East Fork and Pelican Creek.

slope. The measurement which I published in 1872, which was so wide of the mark, was made by a comparison of the vertical angles subtended by a tree at the head of the fall, whose height had been measured, and by the fall. Probably here the source of error was in sighting at the base of the fall, which was very ill-defined, owing to the immense amount of spray and vapor.

I measured the volume of water in the river just at the head of the rapids above the Upper Fall, at the end of August. The amount of water carried by the stream was found to be 1,200 cubic feet per second. This result is little, if any, below the average of the year.

A marked feature of this stream is certain to strike the observer; that is, that it shows no signs of floods. The river flows very nearly bank-full all the year and this although most of its water comes from high mountains. There is no broad flood-plain of bare gravel and bowlders strewn with wrecks of forests. The explanation is as simple and apparent as the phenomenon. The river has a balance-wheel in the form of the lake, by which inequalities of supply are leveled down. It is probable that the river, from the foot of the lake to the mouth of its East Fork, does not vary in level a foot between its highest and lowest stages. The case of Lewis Fork of the Snake is similar, and there we find a similar absence of evidences of floods. Were this idea, thus given to us by nature, carried out on all these mountain streams, the sources of the Missouri, Platte, and Arkansas, the question of controlling the Mississippi in its lower course would be vastly simplified, while the water would be stored for use in reclaiming great areas of land, otherwise arid and desert.

About half way between the two falls, Cascade Creek, a small stream which heads in the southern slopes of the Washburn Range, falls into the river. A few hundreds of yards above its mouth this little stream makes a succession of beautiful cascades, to which the name Crystal Falls has been given. They are three in number, and placed so closely together that they almost form a continuous fall. The total height is 129. Though the amount of water in the stream is small, still from its graceful form this little fall is well worthy a visit.

THE GRAND CAÑON.

This feature, too, has been so frequently described that anything further concerning it is almost superfluous. Commencing at the Falls it extends down nearly to the mouth of the East Fork, a distance, as the river flows, of 24 miles. Indeed, from the falls to the mouth of Gardiner's River the Yellowstone is in a continuous cañon, but the partial break at the mouth of the East Fork separates it into two parts, known as the Grand and the Third Cañons. The former occupies the line of greatest depression in a volcanic plateau, which slopes to the northward and southward from the Washburn group of mountains, and to the westward from the Amethyst Ridge of the Yellowstone Range. Its course is northeast as far as the extremity of the Washburn group, and, after passing that, it turns north with a very slight inclination west. The height of the plateau at the falls is about 7,800 feet. It increases slightly northeastward, until, in passing the mountains, it has an elevation of about 8,000 feet. Thence northward it decreases in height rapidly, and at the mouth of Tower Creek it reaches but 7,200 feet. At the head of the Upper Fall the river level is but a few feet below the top of the plateau. This fall adds 112 and the Lower Fall 300 feet to the depth of the chasm. From the foot of this fall to the mouth of East Fork

the total fall is 1,304 feet in a distance of 24 miles, being an average of 54.3 feet per mile. As far as the extremity of the Washburn Mountains, a distance of 12 miles, the cañon continues to increase in depth, both by the fall of the stream and the rise of the plateau, and the extreme depth, 1,200 feet, is attained at this point. Thence the depth decreases rapidly, and at the mouth of Tower Creek it is but five or six hundred feet deep on the west side, and about 1,000 feet on the east side. The width of the cañon at the top ranges from one-fourth of a mile to one mile, and the angle of slope of the walls from the top to the water's edge ranges from 45° to 75°, with a horizontal line.

The Yellowstone receives several tributaries from each side in its progress down the cañon. From the east, Jasper, Agate, Broad, and Orange Creeks come in, and from the west a number of small streams, heading in the Washburn Mountains. As is usually the case in a land of cañons, these branches have much less erosive power than the main stream, and consequently reach it at a much higher level, necessitating a very rapid slope at the end or an abrupt fall. Many of these streams make very fine falls in reaching the cañon walls. This is particularly the case with the little streams on the west. They flow on the surface of the plateau, with a very gentle current, and have to make the whole descent to the bed of the cañon in a small fraction of a mile. The streams from the east, which head high up in the Amethyst Ridge, have long courses and drain considerable areas. These streams cut cañons of considerable depth before they reach the main stream.

THE WASHBURN MOUNTAINS.

This group stands near the middle of the Park in longitude, and in latitude about one-quarter the length of the Park from its northern boundary. It is in the form of a semicircle, the middle of the convexity being towards the southwest and opening towards the Yellowstone. Its diameter is about 8 miles. The whole of this great amphitheater is drained by Tower Creek and its branches. The group contains altogether about twenty-five summits, ranging in height from 9,000 to 10,400 feet. The highest peak of the group is Mount Washburn, 10,346 feet above sea-level. This peak is very easy of access, and as the trail up the river passes very near the summit it is a very much-visited mountain. Card-receivers, consisting of old peach and sardine cans, are crammed with the names of visitors, from Cabinet officers down to the Toms, Dicks, and Harrys of the great unwashed. The earliest date is that of Lieutenant Doane's (the Washburn) party, 1870.

Southwest of Mount Washburn, and distant from it but 2 miles, is a sharp cone rising to a height of 9,988 feet. This I have named Dunraven Peak, in honor of the Earl of Dunraven, whose travels and writings have done so much towards making this region known to our cousins across the water. This is the peak which rises directly up from the west side of the pass in the Washburn Mountains, on the trail to the Falls.

The southern slopes of the convexity of the Washburn Mountains are drained by small streams flowing into the Yellowstone, the largest of which is Cascade Creek. This stream collects its waters during a very leisurely course through a series of marshy meadows, and enters a cañon only a mile above its mouth. The western slopes of these mountains are tributary to the East Fork of Gardiner's River, while most of the northern slopes drain into the Yellowstone through Blacktail, Geode,

Upper Falls of the Yellowstone.

and Elk Creeks. While the former are quite abrupt, the latter are very gentle and gradual.

The timber-line in this group is at about 10,000 feet above sea, some of the highest peaks reaching above it.

TOWER CREEK.

This stream drains the great amphitheater inclosed by the Washburn Mountains. The stream has three main branches, the uppermost, which continues the name of Tower Creek, Carnelian Creek, which heads in the pass crossed by the trail, and Antelope Creek, which heads in Mount Washburn and flows into the main stream only a hundred yards above its junction with the Yellowstone. The latter is the only branch which has a valley, as the others flow in mountain gorges in their upper courses, changing to plateau cañons farther down. This, although a good-sized stream, has not cut its bed down to the level of the Yellowstone, but at a point about one-quarter of a mile above its mouth it leaps over a cliff 132 feet high* into a deep, dark, gloomy gorge, down which it hurries to join the river. The scenery of this fall is very fine. Above, the stream is a rapid torrent, rushing down a steeply inclined bed, paved with great bowlders, and inclosed between precipitous walls 300 to 400 feet high. At the brink of the falls erosion has left standing many tall, acicular spires of volcanic conglomerate, which give the name to the Fall. From below, we see these spires continued downwards to the lower level, in bas-relief, on the faces of the cliffs. The fall is a clear leap, unbroken by any projection, and the gorge below is so deep and narrow that the sun's rays seldom penetrate it and dispel its gloom.

Descending gradually from the plateau, we enter a small valley on the west side, at the base of the eastern cusp of the Washburn Mountains. The floor of this valley is elevated 200 to 300 feet above the level of the river, whence it descends by steep bluffs.

THIRD CAÑON OF THE YELLOWSTONE.

The cañons on the river are numbered from below. The first or Lower Cañon is a short distance above the great eastern bend of the river, the second extends from a point about 10 miles above the well-known ranch of the Bottler Brothers to Cinnabar Mountain and the Devil's Slide, while the third, commencing at the mouth of Gardiner's River, extends up to the mouth of the East Fork. This differs in many important respects from the Grand Cañon. Though largely carved from volcanic rocks, it is by no means as precipitous. In some places it is cut in granite. The walls are much less even, being broken down in many places. On the south, the country bordering it is a rolling, uneven plateau, covered with grass and sage, with timber only in groves. On the north side the walls are formed by the foot-hills of the Yellowstone Range, which gives a very different character to the orographic forms. Indeed, the walls are so irregular that it is very difficult to speak at all concerning the depth of the cañon. It may be said, however, that the plateau ranges from 7,000 to 8,000 feet, while the river, which, at the mouth of East Fork, is 5,978 feet above the sea, has an elevation at the mouth of Gardiner's River of 5,360 feet. There is no point in this cañon where either wall exceeds 2,500 feet in height.

*Barometric measurement, 1872. Doane makes it 115 feet, Barlow and Heap, 156 feet. Their methods of measurement are not given.

The plateau on the south side of this cañon consists of a long, gentle slope to the northwest from the Washburn Mountains, terminating in a shallow trough extending across the plateau, then a gradual rise towards the north to a summit, followed by an abrupt slope northward down to the river. Most of this plateau is drained by Blacktail and Geode Creeks, which head in the Washburn Mountains. The long branches of the former stream come down the slope of the plateau, collect in the trough above mentioned, and, re-enforced by small streams from the northern slope, break through to the Yellowstone. On the west and north of the depression or trough the plateau breaks down abruptly to the valley of Gardiner's River in a sheer cliff 2,000 feet in maximum height. The summit of the plateau above this cliff is known as Mount Evarts, in honor of a member of the Washburn party, who succeeded in immortalizing himself by getting lost near the south shore of Yellowstone Lake.

GARDINER'S RIVER.

The stream, one of the principal branches of the Yellowstone in its upper course, heads in three large branches, known, in the limited vocabulary of the mountains, as the East, Middle, and West Forks. Of the three the West Fork is by far the smallest. It heads in Sepulchre Mountain, an outlying peak of the Gallatin Range, flows at first south down an open valley, then turning east it cuts through a mountain ridge, which limits the valley of the main Gardiner's River on the west, making a fine fall in the cañon.

The Middle Fork, much the largest of the three, receives most of its water from the Gallatin Range, while some good-sized branches come from the timbered plateaus to the southwest and south. Its longest branch heads in Electric Peak, the highest and finest mountain within the limits of the Park. The stream flows thence south in the same broad, open valley with the West Fork, collecting stream after stream as it issues from among the mountains. Finally, turning eastward, it receives the waters collected from the many springs on the plateaus, cuts its way through the ridge encountered by the West Fork, and is joined by it in the valley below. In the cañon this stream, like the West Fork, makes a very fine fall.

The East Fork joins the main stream about half a mile below the junction of the other two branches. It continues up at first in a southeast course, then turns to the west, and heads in the western and northern slopes of the Washburn Mountains and in the timbered plateaus lying west of them. This stream also makes a fine fall at a point 2 or 3 miles above its junction with the main stream.

Below the junction of these branches, Gardiner's River flows north, making a very straight course to the Yellowstone, bordered on the right by the cliff of Mount Evarts, on the left by a steeply-sloping valley, which terminates in a low cañon wall on the margin of the river.

The celebrated Mammoth Springs are situated about 4 miles above the mouth of the river and 1½ miles back from it, and are elevated above it nearly 1,000 feet.

THE EAST FORK OF THE YELLOWSTONE.

This, the largest branch of the river, in its upper section, heads entirely in the Yellowstone Range, and enters the main stream between the Grand and Third Cañons. Its extreme southern branches drain the mountains as far to the south as the northern shore of Yellowstone Lake, while its

Yellowstone Cañon and Falls.

extreme northern branches head opposite those of Clark's Fork of the Yellowstone. It is, in the main, a rapid stream, and is subject to extreme freshets, as is shown by the ragged condition of its bed, by its rapid erosion, and by the enormous deposits of gravel, bowlders, and dead timber wherever its current is checked. Its course, after the first gathering together of waters, is nearly northward for 25 miles along the base of the Yellowstone Range. It is separated from the Yellowstone by a high, broad ridge, the northern part of which is known as Amethyst Ridge. In this part of its course it is joined by several large streams from the east, which head far in the recesses of the mountains. Of these the largest is Soda Butte Creek, a stream nearly equal in size to the main stream above their junction.

Finally, having reached the end of the Amethyst Ridge, the stream turns west, flows in this course for about 7 miles, and falls into the Yellowstone.

Above Soda Butte Creek the stream is in a cañon, bounded on either side by very high but not precipitous walls. On the right rise the mountain slopes; on the left is a high, rolling country, intersected by shallow valleys, running east and west, *i. e.*, nearly transverse to the courses of the main streams. In each of these valleys are two streams, one flowing east to the East Fork, the other west to the Yellowstone, with a very slightly-marked divide between them. These valleys are bare of timber, forming beautiful little parks, while the ridges between them are densely timbered.

Traveling northward on this divide, between the Yellowstone and its East Fork, we soon leave most of the timber, and, rising a few hundreds of feet, find that the divide has changed its character. It has become a sharp ridge, broken into summits, sloping to the Grand Cañon, and pitching off abruptly to the East Fork, which here, below the mouth of Soda Butte Creek, is meandering lazily down a broad valley, with many crooks and windings. The valley here, for 6 miles, has an average width of about 2 miles. The divide here is known as Specimen Ridge, and one of its summits, on which many fine amethysts have been found, as Amethyst Mountain.

THE YELLOWSTONE RANGE.

This name has been given by Dr. Hayden to the great range which extends from the Yellowstone River southward to Union Pass, and separates the drainage of the Big Horn from that of the upper course of the Yellowstone. It is the range to which Captain Jones, in 1873, gave the name of Sierra Shoshone, under the mistaken idea that it had not yet been christened. His claim to the privilege of naming it is thus stated:*

> As I have been the first to cross them and mark out their geographical position and extent. Professor Hayden has called what he has seen of them and their western border sometimes the "Snowy Mountains" and sometimes the "Yellowstone Mountains," but he has also applied the latter name to a range lying south of Yellowstone Lake that has no existence.

As to the first statement: Captain Jones has crossed this range at two points—at Stinking Water and Togwotee Passes—both near the southern end. He has mapped from his own work, in a rough way, the portion of the eastern slope between these passes, and the range in the neighborhood of these passes. At least three-fourths of the range he never saw. All this was in 1873.

* Report on Reconnaissance of Northwestern Wyoming, p. 21.

In 1871 and 1872, Dr. Hayden's survey mapped, also in a rough way, it must be confessed, the whole western slope of the range, from the south line of the Park to the north end of the range, ascending no less than six of the dominant peaks, and crossing the range in two places, at the heads of Soda Butte and Slough Creeks. Again, I have been unable to find a reference to this range wherein Dr. Hayden speaks of it as anything else than the "Yellowstone Range," and this name recurs in his reports repeatedly. In one place he speaks of it as being represented *on old maps* as the Snowy or Heart Mountains. The fact that on a map of Yellowstone Lake the name Yellowstone is applied to a range south of the lake is due to an error of the draughtsman solely. And, in passing, I may remark that the range in question *has* an existence, Captain Jones to the contrary notwithstanding, if a mass of country 2,300 feet above the lake and 10,000 feet above the sea has any claims to the name of mountains.

Throughout its whole extent this range is extremely rugged. That portion of it lying within the Park is almost entirely volcanic, only a small portion of it near the north line being of granite. It occupies a great breadth, and its peaks range nearly up to 12,000 feet in height. The highest peak yet measured is Index Peak, which stands 4 or 5 miles east of the Park, and has an elevation of 11,702 feet. There are probably many higher peaks, as the great bulk of the range has not yet been explored.

The first large stream entering the Park from these mountains is Hell-Roaring River, which flows into the Yellowstone in the third cañon. It comes from the granite portion of the range north of the Park, cutting a tremendous gorge through it. Reaching a low plateau at the base of the mountains, it changes its course from south to nearly northwest, flowing nearly parallel to the Yellowstone for several miles before falling into it. In the bend of the stream stands a high, sharp, conical peak of granite, a well-known landmark in this region, known as Hell-Roaring Mountain.

The next stream draining Yellowstonewards is Slough Creek, a large branch of the East Fork. At its head a low divide leads over to the head of the Rosebud. Next in order is Soda Butte Creek, a second very large branch of the East Fork. At its head easy passes lead over to the heads of the Rosebud and Clark's Fork of the Yellowstone. About the heads of this stream the mountains become extremely rugged. They are made up of volcanic conglomerate disposed in beds or strata, which have been eroded in such a way as to leave cliffs of various heights, from a few feet only, to thousands of feet. The profiles of the peaks show a succession of steps, of varying magnitudes and relations between the rise and the tread. In this group, and just without the boundary of the Park, are Index and Pilot Peaks, two of the best known landmarks in the region. At their base is the Clark's Fork mining district, at the head of the stream of that name.

South of Soda Butte Creek for a few miles the mountain-forms are less pronounced. Two large eastern branches of the East Fork flow in from a region of smooth, easy, timbered slopes; but at the extreme head of the East Fork the mountains again show themselves in all their original ruggedness. A near view of this portion of the range is surpassingly grand. The material upon which nature has here worked, volcanic conglomerate, is not such as produces spires and pinnacles of the Gothic order, but mainly great, broad masses with precipitous sides and flat summits.

The extremest southern branches of the East Fork head as far to the

Crystal Falls.

south as latitude 44° 35′, opposite branches of the Stinking Water, a large tributary to the Big Horn River.

South of the head of the East Fork the tributaries to the Yellowstone, whether they flow into the lake or into the Upper Yellowstone, are comparatively short, the divide between the Yellowstone and the Big Horn swinging to the eastern part of the range. The mountains also rise more abruptly, with a smaller breadth of foot-hills. Of the prominent peaks in this portion of the range may be mentioned Mount Chittenden, named for Mr. George B. Chittenden, whose name has long been identified with this survey. This fine, prominent peak stands at the head of Turbid Creek, and of a branch of Pelican Creek, while from its eastern base flow the headwaters of the Stinking Water. From its neighborhood a heavy spur runs down to the lake, terminating in Lake Butte. South of this is a deep bay of low country, partially swampy, at the head of which is a very low pass to a branch of the Stinking Water; and, judging from the number of old trails setting in that direction, it is probable that the pass in question is much used by game and Indians. Though it was not practicable to measure its height, it can be but little above the lake, as the slope upwards to it is scarcely perceptible, and the summit is very ill-defined. The stream from it to the eastward has a rapid descent, in a close cañon between high mountains. This bay is limited on the south by the spur known as the Signal Hills, which consist of a series of half a dozen hills running down to the lake shore, each lower than the one west of it, and connected with it by a low saddle.

Next follows a broad valley, drained by Milky Creek, then a high spur, at the head of which stands Mount Langford, named, in 1871, for ex-Gov. N. P. Langford, formerly of Montana. On the spur are two very fine conical peaks, the higher bearing the name of Mount Doane, from Lieutenant Doane, U. S. A., who was in charge of the escort of the first party that explored the Park (General Washburn's); the other, Mount Stevenson, from Mr. James Stevenson, who for many years was the executive officer of this survey.

This spur reaches the lake at its head. South of it the cañons become closer, while the belt of foot-hills and secondary peaks becomes much narrower, and in a few miles entirely disappears, and the highest peaks look directly down upon the valley of the Upper Yellowstone. Farther yet, and the range assumes more the appearance of a high plateau, erosion having acted but little upon the original mountain mass. Some of the earlier maps represent a peak in this neighborhood marked as Mount Humphreys, but I have been unable to identify it.

THE GALLATIN RANGE.

This range separates the Yellowstone from the Gallatin River. But a small portion of it, in length only 15 miles, is within the Park, while it extends northward for a long distance, finally disappearing only against the Missouri River, below its great bend. It is not, however, known as the Gallatin Range throughout. West of Bozeman and Fort Ellis it is very much depressed, falling to an elevation of only about 8,000 feet, and north of this depression it is known as the Bridger Range.

Within the Park the first peak is Electric, the highest and finest peak in that reservation. It has a height of 11,155 feet above sea, and of 6,000 feet above the valley of the Yellowstone at its base. Its summit is double, the eastern peak being the higher. The summit of the latter is very small, not covering a space greater than 10 square feet,

while on all sides but the west, where a knife-like ridge connects with the west peak, sheer precipices extend downward for thousands of feet. The view from this summit is very impressive. North of us, and almost at our feet, the Yellowstone winds its sinuous course down a beautiful valley. In a few miles it flows in among densely-wooded mountains, where it is lost to sight for several miles; then it reappears, more distant, in a second valley, down which it flows until lost in the haze of the distance. East of this stream rises the Yellowstone Range, whose snowy peaks limit nearly half the horizon. East of us Sepulchre Mountain seems but a stone's throw away, and below it is the lower valley of the Gardiner, with the white hill of the Mammoth Springs and the long, straight cliff line of Mount Evarts. From the crest of this extends eastward the plateau of the Third Cañon, while the line of the cañon is scarcely discernible. Farther to the right are the flat summits of the Washburn Mountains. Turning to the south we look down the broad, open valley of the upper waters of Gardiner's River gradually rising and changing into the densely-wooded plateaus about the heads of the southern branches of this stream and Gibbon Fork, and far above it all rises the needle-like peak of the Grand Teton. A few degrees farther to the right include the peaks of the Gallatin Range, over which we see the timbered valley of the Madison, Tyghee Pass, and the mountains about Henry's Lake. To the west and northwest the view is one of peaks, mountain rising above mountain, seemingly in endless confusion, a sea of mountains whose white-tipped waves are sorely vexed by contrary winds.

The mountain is not difficult of access. It can be approached from the north by following up the valley of Trail Creek and riding up the spur next to the peak. By taking this route one can ride nearly to the summit. A shorter route is from the valley of the Middle Gardiner, south of the peak; but here the climb would necessarily be much more concentrated, though shorter, and a much greater distance would require to be made on foot.

Electric Peak is not on the divide between the Yellowstone and Gallatin, but, as is so often the case, the watershed follows a lower and far less prominent ridge, the peak being on a spur separating Gardiner's River from several small streams draining directly into the Yellowstone. This watershed passes three or four miles west of Electric, with a general southward course, but with many windings. It keeps on the west side of the body of the range, presenting an abrupt wall to the westward, with long, heavy spurs, in most cases exceeding in height the watershed itself, trending off to the eastward, and breaking off abruptly in precipices to the valley of the Middle Gardiner. The streams on the east side of the watershed all drain into the latter river, and all flow, while in the mountains, in U-shaped cañons. Altogether the range sends down to the eastward five large streams—Electric, Fawn, Panther, Indian, and an unnamed stream from the south of Mount Holmes.

The structure of this range is very peculiar. It is made up of stratified rocks, dipping northward, *i. e.*, nearly in the trend of the range. Its eastern portion appears to have been eroded away, leaving a line of cliffs at the ends of the spurs. Some of the creeks coming from the mountains have cut cañons, with precipitous walls on both sides, while others have a precipice on the north, while on the south the slope is gentle, following the dip. Electric and Fawn Creeks are of the latter class, while Panther and Indian Creeks are of the former. Quadrant Mountain, between Fawn and Panther Creeks, has a very peculiar shape. The summit, with the northern and western slopes, form a

Grand Cañon of the Yellowstone.

curved surface, roughly resembling a segment of a sphere. On the east and south are almost sheer cliffs from base to summit. On the summit is a little nipple, rising a couple of hundreds of feet above the main mountain, the last remains of higher beds.

The range ends abruptly in Mount Holmes, one of the finest and most prominent mountains in the Park. I have named it after Mr. W. H. Holmes, who has been connected with the survey as geologist and artist since 1872. Farther to the south the divide between the heads of Gardiner's and Gibbon Rivers on the east and the Madison on the west (for in this latitude we are beyond the head of the Gallatin) is borne on a mere swell in the plateau.

THE MADISON DRAINAGE AREA.

Area within the Park, 730 square miles. The Madison is the middle one of the three forks of the Missouri which join at Gallatin City. The portion of the river within the limits of the Park is known more commonly as the Firehole. The stream heads just west of Shoshone Lake, separated from it and the head of Bechler's Fork by relatively low divides. At high water the stream has its source in a small pond, a hundred yards or more across, known as Madison Lake. In the dry season this pond ceases to exist, although a bit of marshy ground indicates its site. The stream at first pursues a northeast course in a narrow valley, then comes a bit of cañon, followed by a like succession of open valley and cañon. The valleys are narrow and marshy, and traveling is not easy. In the second bit of cañon, about 8 miles from its head, the stream turns to the northwest, and in 3 or 4 miles flows out into the Upper Geyser Basin. So far the stream has received no large branches. The principal branch in this portion of its course comes down a deep cañon from the east and enters it at the head of its bend. The stream, however, has grown very rapidly, but it is mainly from springs along the edges of the valley

The Upper Geyser Basin is a valley of about a dozen square miles, nearly flat as to surface, and surrounded by bluff, rocky walls on all sides, except where the Madison (Firehole) and its branches enter and find exit. A full description of this basin, with the others, will be found in Dr. A. C. Peale's report, so that it is unnecessary to enter into further description. At the foot of this Basin the river receives two large branches from the west, Little Firehole River and Iron Spring Creek, which join one another just before entering the main stream.

A few miles of a northerly course, in a narrow valley, between high timbered hills, and the Firehole flows out into the Lower Geyser Basin, a somewhat larger valley, containing about 20 square miles, and limited, but not as closely or abruptly as the Upper Basin, by high hills. At its head a small stream comes in from the east, while at its foot two large streams join it from the west—Sentinel and Fairy Fall Creeks, and a second stream from the east, known as the East Fork of the Firehole. This is a large stream, heading in the Yellowstone divide, opposite Alum Creek and other smaller streams. It has many branches, with short, steep courses, which collect in a basin at the base of the divide, whence the stream pursues a course nearly west, down a narrow valley between high, steep walls. The country south of it and east of the Firehole is high and undulating, with little drainage, and covered with a dense growth of timber.

The Firehole continues in a northwesterly course for 5 miles below the mouth of East Fork, when it is joined by Gibbon River, a large branch nearly equal in size, heading off to the northeast among the densely timbered plateaus opposite the head of Gardiner's River. In

its course between the mouths of these two streams the Firehole has a very rapid current over a bottom broken by immense bowlders, and in one place makes a very fine fall of 60 feet in height.

As was said above, Gibbon River heads in the heavily-timbered, marshy plateaus opposite the heads of the southern branches of the Middle and East Forks of Gardiner's River. The region in which these streams head seems to consist of a succession of broad ridges, trending north and south, and of narrow valleys, in which there are in many cases, low divides, from either side of which a stream flows, one to Gardiner's, the other to Gibbon River. In this way nearly all the larger branches of these streams are connected.

The valleys of these branches are mainly open and very marshy. The streams have but little fall. The two upper branches flow at first toward one another, the one northward, the other southward, in the same valley, meeting near its middle. Then the stream turns to the west and flows in that direction for 2 or 3 miles, receiving a branch from the north, then turns nearly south on entering a large, open meadow, and there receives a second large branch from the north. Crossing the meadow it enters a close cañon, by which it cuts through a high ridge which has limited its drainage basin on the south. In this cañon it has a very rapid current, and at its end it leaps over a fall of about 80 feet. Near this point it turns to a western course and flows thence to its mouth in a narrow valley, with the high ridge above mentioned, rising to a height of 1,500 feet on the right, and the hills separating it from East Fork on the left. The point of junction of the streams has an elevation of 6,872 feet. Below this point the stream is known as Madison River.

The wall which has accompanied the Firehole on the west, with great persistence, and which has grown steadily higher as the stream-level has declined, develops here into a cliff 1,500 or 1,800 feet in height. The ridge on the right, too, approaches the river and becomes precipitous. The river is thus closely confined between two rocky walls forming its upper cañon. This, though close and rocky, is not difficult to traverse. It extends about 8 miles down the river from the mouth of the Gibbon, when it terminates abruptly, and the river flows on in its westward course down a broad, timbered valley.

The region lying west of the Firehole has, in general, the form of an elevated plateau from 8,000 to 9,000 feet above the sea, densely timbered, cut by numerous cañons, and yet containing very little water. It is floored with volcanic rock, and, as is commonly the case, the streams quickly find their way down beneath the surface, where they flow, finally emerging at the base of cliffs in the form of huge springs.

CLIMATE.

This region has a climate essentially its own, differing markedly in many respects from that of any other part of the West. Its atmosphere is moister, its rainfall greater, its mean annual temperature lower than of any other extensive portion of that region, and reciprocally it is better clothed with vegetation, especially with large timber. The forest-covered areas have been indicated in the above description of the topography. It may be added that of the area of the Park—3,312 square miles—no less than 2,751 square miles, or 83 per cent., are covered with dense forests. This region, with the adjacent parts of Idaho and Wyoming, contains the most heavily-timbered area in the West, with the exception of parts of Oregon and Washington Territory lying west of the Cascade Range. These conditions of temperature, moisture, and vegetation will be easily understood when one takes into account the

Index and Pilot Peaks.

great altitude of the Park, which averages 8,000 feet, the latitude 44° to 45°, and the presence of the Yellowstone Range on its eastern border, which acts as a great barrier to the air-currents, forcing them to disgorge whatever moisture they may have accumulated upon the region lying at their western base.

We have no long series of meteorological observations in the Park or in its neighborhood. Our conclusions are necessarily based upon a few observations scattered about here and there, and, though they are amply sufficient to give a general idea of the climate, they give no detailed knowledge, and none whatever directly concerning the winter season.

The climate is, as regards temperature, sub-arctic. The winter begins with September and ends only in June, and frosts are not only liable to occur but actually do occur every month of the year. The following statement of tri-daily and minimum temperatures in August, September, and October illustrates in a general way the range of temperature in the Park during those months:

SHOSHONE GEYSER BASIN.

[Latitude, 44°.21′; longitude, 110°.48′; elevation, 7,837 feet.]

Date.	Temperature.			Relative humidity.			Min. temp.	Remarks.
	7 a. m.	2 p. m.	6 p. m.	7 a. m.	2 p. m.	6 p. m.		
August 14	.....	74	71	.....	.....	56	.....	Atmosphere very smoky.
15	48	70	60	86	55	76	43	Rain in evening.
16	52	59	56	100	88	88	50	Rain last night and all day.
17	51	62	52	93	79	93	47	Do.
18	49	60	49	93	78	100	44	Rain in morning.
19	47	59	57	93	82	81	40	Rain all night; clear in day.
20	40	63	59	100	75	94	36	Clear.
21	44	68	65	100	72	.....	40	Do.
22	47	68	62	100	80	79	44	Rain in afternoon.
23	57	63	62	88	75	89	53	Rain all day.
24	48	71	67	93	60	68	43	Clear.
25	47	69	67	93	52	57	42	Do.
26	39	.....	.....	91	.....	.....	34	Do.

UPPER GEYSER BASIN.

[Latitude, 44°.28′; longitude, 110°.51′; elevation, 7,373 feet.]

August 27	40	75	67	.....	.....	.....	.....	Clear.
28	37	.....	.....	.....	.....	.....	33	Do.
29	54	59	67	87	77	61	.....	Do.
30	44	73	65	84	37	55	35	Do.
31	46	.....	72	.....	.....	34	33	Do.
September 1	36	.....	75	90	.....	35	31	Do.
2	41	.....	.....	100	.....	.....	34	Do.
8	.....	.....	33	.....	.....	.....	.....	Snowed all night and day; 6 inches fell.
9	27	.....	.....	.....	.....	.....	24	Clear and windy.
10	28	50	36	.....	58	.....	24	Clear.
11	26	64	.....	.....	53	.....	23	Do.

WHITE MOUNTAIN HOT SPRINGS.

[Latitude, 44°.58′; longitude, 110°.42′; elevation, 6,387 feet.]

September 16	33	.....	44	.....	.....	100	.....	Clear.
17	32	.....	.....	.....	.....	.....	26	Do.
18	44	.....	56	.....	.....	.....	36	Rain in evening.
19	45	.....	49	.....	.....	.....	38	Clear.
20	37	61	49	100	61	93	32	Do.
21	35	.....	54	.....	.....	65	28	Do.
22	39	45	36	.....	.....	81	39	Weather threatening.
23	25	.....	.....	.....	.....	.....	18	Snowed all afternoon and night and the following day; 8 inches fell.

LOWER GEYSER BASIN.

[Latitude, 44°.35′; longitude, 110°.50′; elevation, 7,236 feet.]

Date.	Temperature.			Relative humidity.			Min. temp.	Remarks.
	7 a. m.	2 p. m.	6 p. m.	7 a. m.	2 p. m.	6 p. m.		
September 30	32	.....	33	.....	.....	.....	.....	Snowed all night and day.
October 1	32	.....	40	.....	.....	.....	30	Flurries of snow all day.
2	28	46	37	.....	.....	.....	21	Clearing.
3	20	.....	39	.....	.....	.....	8	Clear.
4	19	.....	35	.....	.....	.....	16	Weather threatening, with flurries of snow.
5	21	.....	38	.....	.....	.....	18	Do.
6	24	.....	44	.....	.....	.....	22	Do.
7	38	.....	50	.....	.....	.....	29	Do.
8	30	.....	44	.....	.....	.....	30	A little snow last night.
9	42	.....	51	.....	.....	.....	33	Snow last night.
10	24	.....	33	.....	.....	.....	21	Flurries of snow.
11	25	.....	45	.....	.....	.....	23	Clear.
12	41	.....	39	.....	.....	.....	31	Snowing most of day.
13	37	.....	.....	.....	.....	.....	31	Do.

MEANS OF ACCESS, ROADS, TRAILS, ETC.

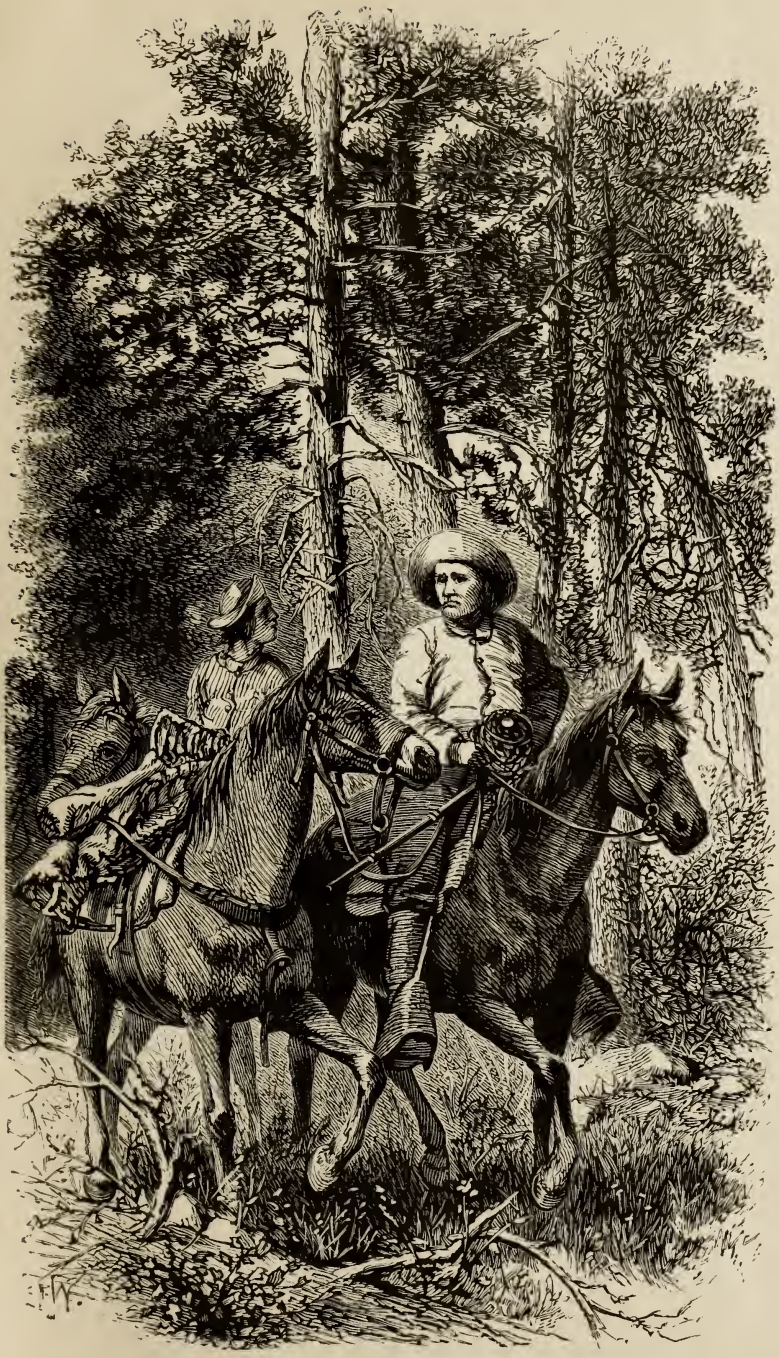
There are well-marked roads or trails connecting most of the points of interest in the Park, while in cases where there are none the character of the country is such that one has no trouble in going wherever he pleases, so that few parties have taken the trouble to follow any established trail, preferring to select their own routes.

From Bozeman to the Mammoth Hot Springs, on Gardiner's River, there is an excellent wagon road. At the springs there are several log houses, used in part for the entertainment of travelers. The sleeping accommodations at present are very primitive, consisting, in lieu of a bedstead, of 12 square feet of floor-room. Every guest is expected to provide his own blankets. We are too far west for bed linen. Cooking arrangements are correspondingly simple. The frying-pan is the universal utensil, serving to cook everything from bread to meat. The fare is simple, and remarkable for quantity rather than quality or variety.

From these springs an excellent pack-trail starts up the Yellowstone, also a wagon trail to the Geyser Basins on the Firehole River. The former follows up Gardiner's River and its eastern fork for several miles, then strikes off across the plateau of the Third Cañon towards the Yellowstone, reaching it at Baronette's Bridge. On the plateau it is joined by a trail coming from the mouth of Gardiner's River. At the bridge it forks, one branch crossing the river and following up the East Fork of the Yellowstone. From the latter a trail goes up Slough Creek, crossing at its head to the Rosebud. Another passes up Soda Butte Creek to the mines on the head of Clark's Fork of the Yellowstone, which are at the base of the two prominent mountains—Index and Pilot Peaks—while the main trail, a few miles above the mouth of Soda Butte Creek, leaves the East Fork, climbs the abrupt mountain on the west, and continues southward along the divide between the Yellowstone and its East Fork for several miles, finally descending to the head of Pelican Creek, which it follows down nearly to Yellowstone Lake.

The portion of this trail between the valley of the East Fork and that of Pelican Creek is very faint and difficult to follow. Indeed, it is here noted rather as a practicable route than one as yet marked by a trail.

The trail up the Yellowstone, on leaving the bridge, continues on the west side of the river, and at first quite near it. It crosses Tower Creek just above the Falls. Then it ascends, by a very easy grade, the long



Return from an Elk Hunt.

spur which separates Antelope from Tower Creek. Passing the shoulder of the spur, where it turns to a southward trend, the trail begins a general descent towards the gorge of Carnelian Creek. For several miles it continues this course on the side of the mountain, crossing the sharp gulches of two or three mountain torrents, and finally reaches the bed of the cañon but a short distance below the head of the creek. Then it goes up a steep ascent to the divide, which has an elevation of 8,867 feet. On the summit is a spring, the water from which drains either way, and which affords an excellent camping place for the ascent of Mount Washburn or Dunraven Peak.

Thus far the trail is excellent, with the exception of the last half dozen miles. There are steep hills at the crossing of two or three gulches, noted above, and the final hill is very steep; also, about the crossing of Carnelian Creek, there are bad, marshy spots.

South of the Washburn Divide the trail skirts the base of the mountains westward, gradually descending to the valley of Cascade Creek. It then follows this valley, which is quite marshy in many places, down to the neighborhood of the Falls of the Yellowstone. It crosses Cascade Creek just above Crystal Fall. Thence to Yellowstone Lake it follows the river quite closely on the west bank.

The Yellowstone is fordable at ordinary stages of water at a number of places. At a ranch known as Henderson's, a few miles below the mouth of Gardiner's River—at the mouth of Blacktail Deer Creek, in the Third Cañon—at a point one mile above Baronette's Bridge, just below the ruins of a second bridge, and in the section between the Upper Fall and the lake, it is easily fordable on every riffle.

There is a well-marked trail completely around the lake, most of the way following its shore quite closely. It turns off from the river-trail, going east, above the Upper Fall, and bears gradually away from the river, crossing Pelican Creek a mile or more above its mouth and reaching the lake first at the head of Mary's Bay. It rounds Steamboat Point, hugging the shore closely. At the mouth of Turbid Creek it is joined by the trail which comes down Pelican Creek. Down the east side of the lake it is well marked, running on the shore or near it, though for long distances it may be out of sight, owing to the dense timber. On account of the marshy nature of the valley of the Upper Yellowstone, the trail has to make a long detour, several miles up it, to get across, and then returns to the lake to avoid crossing a mass of heavy hills which extend to the lake on the south. After leaving the east side of the valley of the Upper Yellowstone, the trail is much less plainly marked. Indeed, from that point on to the springs on the west arm of the lake, there is little sign of travel. The route generally followed skirts the south and west sides of the south arm, passing around the north base of Flat Mountain and the head of Flat Mountain arm. Thence it crosses to the head of the west arm, striking it quite near the group of Hot Springs. Thence the trail, again strongly marked, hugs the shore quite closely around to the foot of the lake.

Returning now to the Mammoth Hot Springs, let us trace the Norris wagon road to the Geyser Basins. This road was built by Col. P. W. Norris, the superintendent of the Park, in the summer of 1878. The route selected is an excellent one, being very direct, involving few hills, and but little work besides clearing out living and fallen timber and corduroying marshy spots.

Leaving the springs the road goes up directly over a divide to the valley of the East Fork of Gardiner's River. Here is a steep hill, sidling in some places and densely timbered. The road is, however,

well built here, much time and labor having been bestowed upon it. Then it goes southward down this valley, crossing this and the Middle Fork, and then following up Obsidian Creek. All this part has involved but little work, the country being open and clear of timber. Some marshy places have required bits of corduroy. In Obsidian Cañon, however, which is very narrow, much chopping and some building were required, and at its head a long section required to be corduroyed. Following this is a few hundred yards which had to be blasted out of the side of an obsidian cliff and built up out of fragments of this rock. Then it skirts Beaver Lake, and crosses the divide at its head, to the waters of Gibbon River. The ascent of this divide on the north is quite steep. Then the road skirts Gibbon Lake and follows down Gibbon River to the Geyser Basin. Here it leaves the river and crosses the Basin, reaching the stream again only at the head of its cañon, thus cutting off a large bend of the river. After following the river through its cañon it leaves it, gradually bearing away to the southwest, and reaches the Firehole a few miles below the Lower Geyser Basin. It follows this stream quite closely to the Upper Basin, where the road at present terminates.

A second wagon road within the Park was built by General Howard's command, in the campaign against the Nez Percés, in 1877. This comes up the Madison River, through its upper cañon, crosses Gibbon River at its mouth, and on reaching the mouth of the East Fork of the Firehole it turns up it, crosses the divide, and goes down to the Yellowstone, reaching it at the Mud Geysers. For a distance of about 4 miles below the mouth of East Fork these roads are coincident. The Howard road is an excellent one, excepting that at several places on East Fork it is very marshy, and that the ascent to the divide on the west involves a very long, steep hill.

General Howard also cut a road down the Yellowstone from the Mud Geysers to Gardiner's River, following, in most places, the route of the trail. This, however, is practically impassable.

While numerous parties have crossed, from various points on the Yellowstone River and Lake, and from Heart Lake, to the Geyser Basins on the Firehole, they have left little or no trail to mark their course. All routes are possible, and the country is such that any one possessed of ordinary woodcraft can make his own trail as easily as he can follow one.

From the Geyser Basins a well-marked trail leads up the Firehole nearly to its head and crosses thence to Shoshone Creek, which it follows down to the Shoshone Geyser Basin at the west end of Shoshone Lake. Thence it skirts the west end of the lake, and the south side, crosses Lewis Fork at the foot of Shoshone Lake, and follows the latter stream down to the forks of the Snake.

Lewis Fork and the Firehole are fordable almost anywhere at ordinary stages of water, and, of course, there is no trouble about the smaller streams of the Park.

The above enumeration covers all the traveled roads and trails. In conclusion it may be said that there are few parts of the Park which cannot be traversed easily by saddle and pack animals without regard to trails. Dense living and fallen timber and marshy areas form the chief obstacles to getting about, and these can easily, in most cases, be avoided.

U S GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, F V HAYDEN, U S GEOLOGIST IN CHARGE

YELLOWSTONE NATIONAL PARK.